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U. S. DEPARTMENT OF AGRICULTURE.

EIGHTEENTH ANNUAL REPORT

OF THE

BUREAU OF ANIMAL INDUSTRY

FOR

THE YEAR 1901.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

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Of the report of the Bureau of Animal Industry, 30,000 copies, of which 7,000 shall be for the Senate, 14,000 for the House, and 9,000 for distribution by the Agricultural Department.

Approved, January 12, 1895.

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1901

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Animal Industry,
Washington, D. C., April 30, 1902.

Sir: I have the honor to submit herewith the Eighteenth Annual Report of the Bureau of Animal Industry, prepared in accordance with the organic act creating the Bureau, and recommend that it be forwarded to the Public Printer for printing.

Respectfully,

D. E. Salmon,
Chief of Bureau.

Hon. James Wilson,
Secretary.

ORGANIZATION OF THE BUREAU OF ANIMAL INDUSTRY.

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Chief clerk: S. R. Burch.

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Inspection division: A. M. Farrington, B. S., B. V. S., chief; E. B. Jones, LL. M., M. D., assistant chief.

Miscellaneous division: Richard W. Hickman, Ph. G., V. M. D., chief.

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Expert in dairy chemistry: George E. Patrick, M. S.

Pathological division: John R. Mohler, V. M. D., A. M., chief.

Zoological division: Ch. Wardell Stiles, M. S., A. M., Ph. D., zoologist; Albert Hassall, M. R. C. V. S., acting assistant zoologist.

EXPERIMENT STATION.

Superintendent: E. C. Schroeder, M. D. V.; expert assistant, W. E. Cotton.

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EIGHTEENTH ANNUAL REPORT OF THE BUREAU OF ANIMAL INDUSTRY.

REPORT OF THE CHIEF OF THE BUREAU.

The past year has been one of great prosperity in all branches of the animal industry. Prices have been good, markets have been active, and there has been an outlet in foreign countries for most of our surplus.

GROWTH OF THE BUREAU'S WORK.

The work of the Bureau has been greater than ever before, and yet the facilities at its command have not been sufficient to meet the demands that have been made upon it. The magnitude of the interstate and foreign traffic in animals and their products and the amount of work required to inspect and certify to these subjects of commerce are enormous. The diseases which appear in various parts of our extensive territory each year are numerous, and there is urgent need for assistance to protect the affected communities from disastrous losses. Of scarcely less importance is it to investigate the incorrect reports of Old World plagues which are from time to time alleged to exist among our animals. These mistaken reports alarm our stock raisers, injuriously affect our markets, and lead to prohibitions by foreign countries.

OUTBREAKS OF ANTHRAX.

The past year has been remarkable for the number and wide distribution of the outbreaks of anthrax. There are certain regions where this disease appears to be indigenous, as on the alluvial soils of portions of the southern part of the Mississippi Valley, and where it apparently develops when the conditions of the soil and climate are favorable. There are, however, other outbreaks which occur as the result of importing the contagion with hides, hair, wool, etc. In either case the stock owners should be promptly informed of the nature of the disease, of its communicability to man, of its deadly nature, and of the measures required to arrest its spread.

One of the greatest resources in the fight against anthrax is the use of a properly prepared vaccine. That supplied commercially is often unreliable. Sometimes it is so virulent that it is more dangerous than the disease it is designed to prevent; in other cases it is so lacking in activity as to be worthless. There is, however, no good reason why anthrax vaccine of proper strength should not be supplied, as blackleg vaccine has long been supplied, by this Bureau. It is only a question of having the laboratory facilities and the money for properly conducting the work.

Arkansas, Louisiana, Mississippi, and Texas have lost millions of dollars' worth of horses, mules, cattle, and other animals, and an undetermined number of human beings from this disease. Other States, among them Pennsylvania, New York, Illinois, Wisconsin, and the Dakotas, have suffered to a greater or less extent. Numerous requests for vaccine have come from the people of these sections, but it could not be supplied in any instance. More laboratory facilities and more men of thorough training must be had before this line of work can be attempted.

BLACKLEG VACCINE.

Blackleg vaccine has been supplied in greater quantities than ever before, but the facilities which the Bureau now has are not sufficient to keep pace with the demands. More than 1,500,000 doses were distributed to cattle raisers last year, and this gave the most favorable results, the losses in the vaccinated herds being less than 1 per cent of the total number.

TUBERCULOSIS.

The tuberculosis question is one which demands immediate and thorough investigation. This disease is increasing among our cattle and swine, probably also among our sheep. The value of the meat which must be destroyed each year on account of it is becoming considerable. Questions have recently been raised as to the communicability of animal tuberculosis to mankind which are of the highest importance, and should be settled at an early day. The disease is one which not only threatens the prosperity of the farmers who own the stock, but according to the weight of medical opinion at this time it is also a menace to the consumers of their products. Fortunately, the cattle of the United States are affected in less proportion than are those of any other large cattle-producing country, and it is the part of wisdom to arrest the plague now rather than to wait until the losses become greater, and the task of eradication still more difficult to accomplish.

PRESENT SALARIES FOR SCIENTISTS INSUFFICIENT.

The scientific work which is required in connection with the manufacture of anthrax vaccine, blackleg vaccine, tuberculin, mallein, and the study of diseases is of the most difficult character, and is always attended by the danger of infection with the contagion of such fatal diseases as anthrax, tuberculosis, glanders, or rabies, or with blood poisoning from handling the septic products developed in such diseases. There are few men who are qualified to do such work, and their salaries should be proportional to the difficulties and dangers which they necessarily encounter. The pay of the scientific men connected with this Bureau has been so inadequate that it is difficult to induce competent men to remain after they have learned our methods and had the advantage of a brief period of experience in the laboratory.

The result is that much of our time is spent in training young men, who, as soon as they become competent, are called away to other positions where the salaries are higher. It has been said that these men remain in the country and the country has the benefit of the training which they have received here, and while this is true to a certain extent, it does not improve the situation from the farmer's point of view. These men do not necessarily continue in the same line of work. Some of them go as teachers where they are no longer engaged in original research; some of them go into commercial houses; and others may go into medical or veterinary practice. In all of these cases their services are absolutely lost to the field of agricultural investigation. It will probably be generally admitted that the Department of Agriculture exists for the benefit of the agricultural industry, not to educate men for professors in universities, for experts in commercial houses, or for practitioners of medicine; and, while it is desirable that men should be educated somewhere for such lines of work, their training is not a fair compensation to our stock raisers for delay in the solution of urgent and important problems or for failures to bring relief from constant and distressing losses.

While we stop to train men to fill the places vacated, the expense of maintaining the laboratory goes on, the salaries now established go on, the experiment station must be kept in operation, but the work does not progress as it should. During the past six years the position of chief of the Pathological Division has three times become vacant, and most of our investigators have been tendered positions with higher salaries than they are receiving here. As it requires at least two years for a new man, however competent he may be by education and preliminary training elsewhere, to become familiar with our methods, to understand our problems, and to get any reliable results from his experiments, it is readily seen that such frequent changes almost prevent the solution of the more serious and complicated questions with which we are confronted. To elucidate the practical questions connected with the control of hog cholera, for instance, requires a long series of experiments without interruption, and conducted by the same person.

It should be clear, however, that these remarks relative to educational work are not antagonistic to the policy of taking young men from colleges and technical schools into the laboratories and training them for the higher and more responsible positions. This is undoubtedly the best plan for securing competent and experienced investigators, who upon promotion are able to take up the most advanced work with the least loss of time. It is not the educational process that the writer deplores, but the loss of men from this service almost as soon as they have been fitted for it at such an expense of time and money.

It is therefore very desirable and, indeed, essential to the successful prosecution of the scientific work which the Bureau should do that the salaries be made equal to those paid in educational institutions and in other branches of scientific work conducted by the Government. There is no apparent reason why a scientific man should work for less compensation in the Department of Agriculture than in other departments of Government service requiring no more training and no greater competency. As a matter of fact, they will not do so, and the work of agricultural investigation suffers accordingly. I would therefore most urgently recommend that the compensation of the chiefs of the scientific divisions of this Bureau and their more important assistants be made commensurate with the high class of work required of them.

MEASURES TO EXCLUDE CONTAGION.

The maintenance of properly equipped and efficient quarantine stations is essential to the protection of our live stock from imported contagion. The increased value of animals of all kinds in the United States has led to large importations and to correspondingly greater danger of bringing disease into the country. There may be a reasonable doubt as to whether it is necessary or even advantageous to bring any new breeds of animals or any fresh blood of old breeds into this country, but there can be no question that it would be far better to have no more breeding stock imported than to allow the entrance of diseased animals which are capable of spreading contagion among our domestic stock and causing heavy loss to our farmers for years to come. Foreign countries in which we desire to market live animals are from time to time making inquiries as to the value of our quarantine stations and the protection which we give to our live-stock industry. It may be, therefore, that the continuance of our exports in the countries to which we now ship, as well as the extension of our trade to countries where it is desired to establish a trade, is dependent upon our exclusion of diseased animals.

The quarantine stations now in use have been sufficient in the past, but with the growth of the import trade more facilities are required. Ground for a station for the quarantine of animals entered at the port of New York has recently been purchased at Athenia, N. J., and buildings are now in course of erection. The increased cost of building material and the greater number of buildings required make it impossible to equip properly this station for the money which has been appropriated. The work should therefore be continued another year. There is also great need for a quarantine station on the water front, to which animals can be taken by boat in all cases where there is any suspicion that they may have been exposed to disease. This would be far safer than transportation by rail, as at present. There is no place so situated available near New York, and it would therefore be advisable to purchase land for such a station somewhere on the extensive shore line in the vicinity of Baltimore. The quarantine station for the port of Baltimore, now located at St. Denis, Md., needs extensive repairs or entirely new buildings, and consequently this would be a favorable time to make a change.

With a station such as is contemplated, animals might be admitted which we are now obliged to exclude. All cattle, sheep, and swine from the Continent of Europe, for example, are now forced to enter through the Canadian quarantines, because of the prevalence of foot-and-mouth disease in Europe and the danger that would be connected with the transportation of such animals by rail immediately after landing, even if they were apparently sound on inspection. In the history of the quarantine stations, before they were administered by the Bureau of Animal Industry, there are several instances in which foot-and-mouth disease was not detected by the inspection on shipboard, although the animals were actually affected. Such instances are liable to occur again, and emphasize the importance of adopting every possible precaution. An outbreak of foot-and-mouth disease would cause not only great loss to our stockmen whose animals were affected, but it would probably lead to the prohibition of our cattle and sheep by other countries. The recent destruction of the magnificent live-stock trade of Argentina by an outbreak of this disease should be a warning as to what may at any time happen to the United States if our vigilance is relaxed or if we fail to adopt every precaution that may be reasonably suggested from an intimate knowledge of this elusive contagion.

A disease which can not be excluded even by quarantine is tuberculosis. The slow and insidious nature of this disease, the difficulty of detecting it, the fact that it may be communicated to all species of animals, and its generally fatal character, make it by far the most dangerous and injurious of the plagues which threaten our live stock. Unfortunately it has already become so well known that familiarity has bred contempt, and its powers for evil are not fully appreciated. Notwithstanding the tuberculin test, it is to be feared that tuberculous cattle sometimes gain entrance to this country by the fraudulent practice of treating them with this agent before the regular test is made, and thus putting them into a condition which prevents them from showing its effects. As animals imported for breeding purposes are generally sold either to some breeder of high-class stock or to some farmer or dairyman who is grading up his cattle, every tuberculous animal imported is liable to start a new center of disease, and every center of disease so established becomes a distributing point for the contagion and causes an amount of damage which can not be fully appreciated until years afterwards. As has been officially determined of a celebrated herd in Canada, wherever cattle from that herd were found there also was found tuberculosis, "and the Bow Park herd, which was looked upon as one of the greatest benefits to the farming community in western Canada, was really a danger, because it disseminated tuberculosis among the ordinary farmers' herds."

In the same way our owners of purebred herds are not only courting danger to their own herds when they admit doubtful cattle from abroad, but they are liable to disseminate the disease through the herds of many innocent purchasers of their stock. Notwithstanding this fact, there is an unreasonable and insistent demand by the speculators and others interested in the handling of such stock that the regulations be relaxed to such an extent that the detection of diseased cattle would be impossible. The very fact of this insistence indicates that the present regulations are found inconvenient, and that a profitable though dangerous traffic has been checked. It is needless to add that these regulations should be enforced in the interest of our farmers, in the interest of the public health, and in the interest of our export trade, and if the present restrictions are not sufficient to exclude disease they should be added to and made more rigid until the object is accomplished.

FOREIGN MARKETS FOR LIVE STOCK.

The number of cattle and sheep exported during the past year shows a gratifying increase of this branch of our trade. Most of these animals have gone to Great Britain for immediate slaughter. It is believed that the time has come when an effort should be made to introduce our fine breeding animals to the stockmen of other countries. Our herds are now as good as any in the world. The importation of breeding stock from Europe is, except in very rare cases, for speculation only, not because the blood is needed to improve our animals; and during recent years the tendency of such importations has often been detrimental rather than beneficial. This tendency is fully appreciated by the breeders, as is shown by the almost prohibitive registration fee which has been imposed by the Shorthorn Association.

The Argentine Republic has long been importing high-priced breeding stock from Europe, but recently has prohibited the trade on account of the danger of admitting disease from that section of the world. The stockmen of Mexico begin to realize the benefits which would accrue to them by producing animals which would conform more nearly to modern requirements. South Africa, stripped of its live stock by the exigencies of a long and stubbornly contested conflict, must in the near future be rehabilitated and begin anew the development of an extensive pastoral industry. What is more natural than that the finely bred and healthy herds of the United States should be drawn upon to supply the wants of these countries?

Just at present the demand for such stock at home is almost too great to favor very active efforts to build up an export trade. But this condition will not long continue because the stimulus of good prices will lead to much greater production and then a foreign outlet will be very desirable. An export trade can be built up, however, only by supplying the highest quality of stock and that which is free from disease. Of foot-and-mouth disease and pleuropneumonia we are free, and probably shall remain free, but the attention of the world is now turned to tuberculosis, and we should put our herds in condition to also guarantee freedom from that plague. Argentina, Australia, and New Zealand have felt the disastrous effects of tuberculous breeding stock, and it is not likely that any country hereafter will admit such animals without the most rigid tests. Neither should animals be admitted into the United States without these tests, if the reputation of our herds is to be maintained.

IMPROVEMENT IN CATTLE SHIPS.

There has been great improvement recently in the vessels carrying live stock to Great Britain, as a consequence of the Department regulations requiring wider alleyways and better ventilation. In some of the older ships it was impossible to widen the alleys to the extent demanded without too great interference with the carrying capacity, and in these the object sought was attained by running alleys athwartship and increasing the ventilation. It is believed that now, after a continuous struggle for ten years, these vessels are at last in condition to carry animals humanely and without unnecessary loss. During this long period one concession after another has been obtained from the transportation companies, some willingly and some unwillingly, with the result that a gradual improvement has followed.

There remains still in an unsatisfactory condition the method of securing attendants to take care of the cattle during the ocean voyage. At present, many of these men are ignorant foreigners, unable to speak our language, who are engaged under misrepresentation as to the character of the work and with promises of compensation and of a return passage, which are never made good. The result is great hardship and cruelty to the men and lack of attention to the cattle, because the men are not familiar with the work and perform it only under compulsion.

No efficacious method of correcting this evil has yet been devised, but it is now receiving the attention of the several departments of the Government which are interested, and it is hoped that some practical measure will be evolved.

INCREASE IN MEAT INSPECTION.

The number of cities where meat inspection is conducted has been increased by 13 per cent during the year; the number of carcasses inspected at the time of slaughter increased by 2,300,000. This, of course, means that the expense of the inspection is also increasing. However, meat inspection is a service of great value to the country, protecting consumers from diseased meats and maintaining the reputation of our animal products in both home and foreign markets. At present the field is not covered. There are many abattoirs asking for inspection to which the service can not be extended. The work must therefore continue to grow for some years, but arrangements should soon be made to inspect all meat shipped from one State to another. Until this is done, the objects in view when the service was established shall not have been entirely accomplished.

INSPECTION OF DAIRY PRODUCTS FOR EXPORT.

At the last session of Congress provision was made for the inspection and certification of dairy products intended for exportation. The regulations for carrying this measure into effect have been made and the inspection will soon be commenced. The cost of this inspection can not be estimated in advance, but it will necessarily increase the Bureau expenditures, though not largely, considering the benefit that should accrue. At a time when butter substitutes, renovated butter, and all grades of dairy and creamery butter are exported from this country, it is necessary for the protection of our pure butter in the markets of the world that there should be a proper official inspection and certification before the goods leave this country. Practically the same may be said in regard to cheese. The trade is large and increasing, and is entirely worthy of this degree of Government supervision. Whatever the cost may be, therefore, it is an expenditure wisely made, and one which will be of assistance to the dairy industry. It is the intention to extend this inspection gradually, first certifying to the better grades of pure butter and allowing other grades to go upon their merits, but later perhaps marking all grades.

STATE RESTRICTIONS ON INTERSTATE CATTLE TRAFFIC.

Inspection laws and regulations are enforced in a few States (which duplicate the inspection made by this Bureau) of animals that are shipped from one State to another, and for such State inspection fees are demanded which constitute a serious burden on this branch of interstate commerce. The State inspection and tax is applied to live stock which is simply in transit across the territory of the State as well as to that which is destined to remain within its borders. It is plain that the imposition of such taxes on the live-stock traffic by a few States may be followed by the general adoption of this method of raising revenue, and that this would work to the great disadvantage or possibly to the ruination of the stock industry in sections of the country which are remote from market. It would be next to impossible, for instance, to ship cattle from Massachusetts to California, if every intermediate State whose territory was crossed en route should require inspection and exact a fee for the same. So menacing is this situation to the great cattle industry of the Southwest and West that efforts are being made by the National Live Stock Association to bring the matter before the Supreme Court of the United States, in order that a decision may be rendered as to the constitutionality of these State restrictions upon interstate commerce, when Congress has already legislated upon the subject, and provided an adequate inspection service. I would recommend that the Department of Agriculture take such action as it properly may to interest the Department of Justice, and to secure its assistance in presenting the case.

INSPECTION DIVISION.

MEAT INSPECTION.

The number of abattoirs and packing houses where cattle, sheep, calves, and hogs and their products were inspected during the year was 156. The number noted in the preceding report was 148. The number of localities where the work was conducted increased from 45 to 51. Horses were inspected at one other abattoir.

The following table shows the increase, year after year, in the number of abattoirs where inspection has been maintained and the number of cities where the work is done:

Number of abattoirs and cities where inspection was maintained, 1892 to 1901.

Fiscal year.	Number of abattoirs.	Number of cities.	Fiscal year.	Number of abattoirs.	Number of cities.
1892	28	12	1897	128	33
1893	37	16	1898	135	35
1894	46	17	1899	138	41
1895	55	19	1900	148	45
1896	102	26	1901	156	51

The following table shows the numbers and kinds of animals inspected before slaughter, and the number of these that were rejected for some cause apparently unfitting them for food purposes, the final condemnation or passing of the carcass depending upon the result of the postmortem inspection:

Antemortem inspections for the fiscal year 1901.

Kind of animal.	For official abattoirs in cities where inspections were made.	For abattoirs in other cities, and miscellaneous buyers.	Total inspections.	Rejected (subject to result of postmortem inspection).	
				At abattoirs.	In stock yards.
Cattle	5,375,315	4,904,883	10,280,198	318	14,727
Sheep	6,662,032	4,571,827	11,233,859	890	7,682
Calves	400,241	266,235	666,476	1,635	2,173
Hogs	24,486,130	9,700,656	34,186,786	5,812	71,286
Horses	1,991	....	1,991	3	....
Total	36,925,709	19,443,601	56,369,310	8,658	95,868

There was an increase over last year in the number of all classes of animals inspected, with the exception of a decided decrease in the number of horses, there being but a third as many of these as during the previous year. The total number of antemortem inspections this year exceeds the total number of last year by 3,281,316. There was an increase of 2,700 rejections at abattoirs and a decrease of 57,693 rejections at stock yards.

The following table, showing the total number of animals inspected at time of slaughter for abattoirs having inspection, for the fiscal years 1891 to 1901, is given for the purpose of comparison:

Number of animals inspected at slaughter for abattoirs having inspection, fiscal years 1891 to 1901.

Fiscal year.	Cattle.	Calves.	Sheep.	Hogs.	Horses.	Total.
1891	83,889	....	....	....	....	83,889
1892	3,167,009	59,089	583,361	....	....	3,809,459
1893	3,922,079	92,947	870,512	....	....	4,885,538
1894	3,861,594	96,331	1,020,764	7,648,146	....	12,626,835
1895	3,704,042	116,093	1,428,601	13,616,539	....	18,865,275
1896	3,985,484	256,905	4,629,796	14,250,191	....	23,122,376
1897	4,242,216	273,124	5,209,161	16,808,771	....	26,533,272
1898	4,418,738	244,330	5,496,904	20,893,199	....	31,053,171
1899	4,382,020	246,184	5,603,096	23,836,943	3,332	34,071,575
1900	4,841,166	315,693	6,119,886	23,336,884	5,559	34,619,188
1901	5,219,149	413,830	6,639,212	24,642,753	1,992	36,916,936

The inspection of animals at time of slaughter, with the number of carcasses and parts of carcasses condemned and tanked, is shown in the next table. The number of condemnations for trichinosis is given under the head of "Microscopic inspection of pork."

Postmortem inspections for the fiscal year 1901.

Kind of animal.	Number of inspections.			Carcasses condemned.			Parts of carcasses condemned at abattoirs.
	For official abattoirs.	On animals rejected in stock yards.	Total.	For official abattoirs.	Animals rejected in stock yards.	Total.	
Cattle	5,219,149	25,005	5,244,154	8,505	3,777	12,282	8,701
Sheep	6,639,212	7,349	6,646,561	2,936	1,513	4,449	91
Calves	413,830	750	414,580	385	150	535	24
Hogs	24,642,753	77,729	24,720,482	47,240	7,394	54,634	10,973
Horses	1,992	....	1,992	103	....	103	....
Total	36,916,936	110,833	37,027,769	59,169	12,834	72,003	19,789

In addition to the carcasses condemned as above and to those condemned for trichinosis, the table below shows the number tanked for other reasons—bodies of dead animals taken from cars or pens at abattoirs or animals that, after inspection in the stock yards, had died from disease or injury or were killed by municipal inspectors:

Manner of death.	Cattle.	Sheep.	Calves.	Hogs.	Horses.	Total.
Died in stock yards	316	1,147	118	2,215	....	3,796
Killed in stock yards	497	600	158	9,203	....	10,458
Died at abattoirs	239	1,061	257	15,388	27	16,972
Total	1,052	2,808	533	26,806	27	31,226

Below is a statement of the total number of carcasses and parts condemned and tanked, with the causes of condemnation, at the time of slaughter, and including the carcasses of animals found dead and those killed by city inspectors:

Causes of condemnation of carcasses and parts of carcasses for fiscal year 1901.

Cause of condemnation.	Cattle.		Sheep.		Calves.		Hogs.		Horses.
	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.
Actinomycosis	1,355	629	2	....	5	....	26	3	....
Tuberculosis	6,454	256	134	....	8	....	8,650	44	....
Cholera and swine plague	....	....	....	....	....	....	37,862	....	....
Texas fever	17	....	....	....	12	....	....	....	....
Echinococcus	1	1	1	....	....	....	....	620	....
Measles	....	....	....	10	....	....	24	....	....
Scabies	....	....	26	....	....	....	87	....	....
Eczema	....	....	....	....	....	....	6	....	....
Erysipelas	....	....	....	....	....	....	23	....	....
Cancer	63	....	2	....	....	....	18	....	....
Tumor	21	8	5	....	1	....	480	668	....
Abscess	98	6,485	110	11	6	4	597	1,570	6
Pneumonia	213	....	177	....	15	....	978	....	3
Pleurisy	13	....	23	8	1	....	88	13	1

Causes of condemnation of carcasses and parts of carcasses for fiscal year 1901—Cont'd.

Cause of condemnation.	Cattle.		Sheep.		Calves.		Hogs.		Horses.
	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.
Bronchitis									
Carditis							2		
Enteritis	36		62		14		286		3
Peritonitis	177		52		16		373		1
Metritis	9		6				117		3
Nephritis	7		63		2		44		
Uremia	1		27				30		
Mammitis	1		4				15	400	
Septicemia	268		212		6		684		17
Pyemia	200		183		12		1,899		4
Gangrene	12		6				33		1
Anemia, emaciation, marasmus	2,173		1,835		47		299		11
Ascites	19		51		1		27		
Jaundice	26		258		4		774		
Extreme temperature, various causes	2		41		4		595		
Pregnancy	76		25				269		40
Recent parturition	15		15				63		
Hernia	2		4				31		
Downers, bruised, injured, etc	1,020	1,322	759	62	52	20	254	7,655	4
Asphyxiation	3								
Sick			31						
Caseous lymphadenitis			333						
Impaction of rumen			1						
Distoma			1						
Melanosis					1				2
Polyarthritis					1				
Too young					327				
Lymphangitis									1
Pharyngitis									1
Nasal discharge									2
Fistula									1
Distemper									2
Dead from various causes	555		2,208		875		17,603		27
Killed by city inspectors	497		600		158		9,203		
Total	13,334	8,701	7,257	91	1,068	24	81,440	10,973	130

The meat-inspection tag or brand was placed upon 18,977,943 quarters, 332,399 pieces, and 2,844 sacks of beef; 6,626,729 carcasses of sheep; 412,721 carcasses of calves, and 1,101,961 carcasses of hogs, and 752,805 sacks of pork.

The stamp signifying that the contents had received the ordinary inspection was affixed to 21,496,109 packages—6,394,065 of beef, 41,933 of mutton, 112 of veal, 15,059,118 of pork, and 821 of horseflesh.

There were sealed (with numbered seals, of which a record is kept) 68,495 cars containing inspected meat products for shipment to official abattoirs and other places.

The number of certificates of ordinary inspection issued for meat products for export, exclusive of horseflesh, was 36,998. Of beef, there were 1,749,817 quarters, 330 bags, 36,554 pieces, and 1,437,553 packages, with a weight of 452,830,373 pounds; of mutton there were 452 carcasses and 18,990 packages, weighing 894,648 pounds; of pork there were 53,203 carcasses and 717,749 packages, the weight being 231,144,938 pounds. These figures show an increase in the exports of beef and mutton, but a falling off in pork, the total difference being (in round numbers) 26,000,000 pounds less than in 1900—the gain of 15,000,000 in beef being offset by a loss of 40,000,000 in pork. In 1900 there was an increase over 1899 of 77,000,000 pounds in beef, and a decrease of 6,000,000 pounds in pork.

There were 9 certificates given for horseflesh, covering 880 packages, having a weight of 249,900 pounds.

The following table shows the quantities of beef, mutton, and pork for export which received the certificates of inspection:

Quantities of beef, mutton, and pork for export upon which certificates of inspection were issued, 1898 to 1901.

Fiscal year.	Beef.	Mutton.	Pork.
	Pounds.	*Pounds.*	*Pounds.*
1898	339,650,091	324,996	244,956,482
1899	360,843,856	525,705	278,696,435
1900	438,138,233	680,897	272,050,663
1901	452,830,373	894,648	231,144,938

The expense incurred on account of the work outlined above was $566,809, an increase over last year of $61,528.48. The cost of each of the 56,369,310 antemortem inspections averaged 1.01 cents.

The following statement shows the cost of each antemortem inspection from 1893 to 1900, inclusive:

	Cents.		Cents.
1893	4.75	1898	0.80
1894	1.75	1899	.88
1895	1.10	1900	.95
1896	.95	1901	1.01
1897	.91		

MICROSCOPIC INSPECTION OF PORK.

The number of carcasses of pork examined was 733,196, classified as follows: Class A (free of all appearance of trichinæ), 715,529, or 97.59 per cent; Class B (containing trichina-like bodies or disintegrating trichinæ), 8,668, or 1.18 per cent; Class C (containing living trichinæ), 8,999, or 1.23 per cent. There is little change in the percentages; Class A slightly increased, with a corresponding diminution in Class C.

There were 9,001 trichinous carcasses disposed of during the year; the weight of these was 2,003,858 pounds. Over half of this quantity was made into cooked meat; the remainder was tanked.

The decrease in the exports of microscopically examined pork continued, so that the quantity inspected for export amounted to less than two-thirds of that of the year before. The number of certificates issued was 6,188; the number of packages was 127,017, with a weight of 35,942,404 pounds. For comparison the quantities inspected for export to countries requiring microscopic certificates for 1892 to 1901 are given:

	Pounds.
1892	22,025,698
1893	8,059,758
1894	18,845,119
1895	39,355,230
1896	21,497,321
1897	42,570,572
1898	120,110,356
1899	108,858,149
1900	55,809,626
1901	35,942,404

The expenditures on account of this work amounted to $114,102.76. This gives an average for each examination of 14 cents; for each pound exported, of 0.317 cent.

INSPECTION OF VESSELS AND EXPORT ANIMALS.

The number of certificates of inspection issued for American cattle exported to Europe was 1,563; the number of clearances of vessels carrying inspected live stock was 988. There was a notable increase in the number of cattle and sheep exported, the former being greater than in any year since 1898 and the latter the largest since 1896. There was a decline in the exportation of horses. All of the animals in the following table were exported to Great Britain, with the exception of 80 cattle, 590 sheep, and 858 horses to Belgium, and 914 horses to Germany:

Number of inspections, etc., of American and Canadian animals, fiscal year 1901.

Kind of animal.	American.				Canadian.		
	Number inspected.	Number rejected.	Number tagged.	Number exported.	Number inspected.	Number rejected.	Number exported.
Cattle	804,578	1,682	400,385	[a]384,722	33,385	13	33,372
Sheep	398,845	606	....	[b]227,934	49,209	67	49,142
Horses	47,679	263	24,235	[c]24,952	582	....	582

[a] 9,780 via Canada. [b] 13,552 via Canada. [c] 267 via Canada.

Besides the above-mentioned animals exported to Europe, there were also inspected 800 cattle, 514 sheep, and 1 horse for Bermuda and 82 cattle for Brazil.

The number of American and Canadian animals landed alive at the foreign animals wharves in London, Liverpool, and Glasgow and inspected by inspectors of this Department stationed at those ports, together with the number and percentage lost in transit, is shown as follows:

Number of animals inspected at time of landing in London, Liverpool, and Glasgow and loss in transit, fiscal year 1901.

From—	Cattle.			Sheep.			Horses.		
	Landed.	Lost.		Landed.	Lost.		Landed.	Lost.	
	No.	*No.*	*Per ct.*	*No.*	*No.*	*Per ct.*	*No.*	*No.*	*Per ct.*
United States	366,629	868	0.24	207,477	1,913	0.91	22,823	400	1.72
Canada	28,975	110	.38	46,850	425	.90	528	10	1.86
Total	395,604	978	.25	254,327	2,338	.91	23,351	410	1.73

INSPECTION OF IMPORTED ANIMALS.

The numbers and classes of animals imported from Mexico and inspected at ports of entry along the international boundary line are given in the following table:

Importation of Mexican animals, fiscal year 1901.

Port of entry.	Cattle.	Sheep.	Swine.	Goats.	Horses.	Asses.
Eagle Pass, Tex	3,640				3	6
El Paso, Tex	49,413			2	94	
Naco, Ariz	207					
Benson, Ariz	29					
Nogales, Ariz	41,682			143		2
San Diego, Cal	1,680	1,357	37	1,272		1
Total	96,651	1,357	37	1,417	97	9

Through ports on the seacoast, animals not subject to quarantine were imported as follows:

From—	New York.		Boston.		San Francisco, horses.	Total.
	Horses.	Mules.	Horses.	Shetland ponies.		
Europe	1,217		23	3		1,243
Cuba	16	700				716
Brazil		2				2
Bermuda	16					16
Porto Rico	4					4
Hawaii					5	5
Manila					7	7
Mexico	3					3
China					1	1
Canada			23	1	3	27
Total	1,256	702	46	4	16	2,024

There were also 1 deer imported from Manila through San Francisco and 6 sheep from Canada through Boston.

A report of the animals imported and quarantined at different stations will be found under the head "Miscellaneous division."

CONTROL OF CONTAGIOUS DISEASES.

Southern cattle inspection.—The supervision of the movement of cattle from the area quarantined on account of Southern, or Texas, or splenetic, fever of cattle, due to the presence of the tick (*Boophilus annalatus*, formerly called *Boophilus bovis*) which carries the infection, involved the proper yarding in the quarantine divisions of the different stock yards of 1,168,935 head of cattle during the quarantine season of 1900. To transport these cattle required 43,952 cars, each of which had to be placarded, and all of the waybills, manifests, and bills of lading accompanying the shipments had to state that the cattle were Southern cattle. The number of cars cleaned and disinfected was 45,425.

In Texas 307,658 cattle were inspected and identified by brands as originating outside of the quarantined district and were permitted to be moved north for grazing.

Scabies in sheep.—The number of sheep inspected in stock yards, at feeding stations, and at many places throughout the West, in order to prevent the shipment of sheep affected with or that had been exposed to scabies, amounted to 7,912,724.

The number of sheep dipped under the supervision of Bureau inspectors was 1,034,368.

For shipments of sheep that were found free of infection, certificates of inspection were given.

MISCELLANEOUS DIVISION.

The miscellaneous division has a general supervision of the accounts and other work of the Bureau of Animal Industry, as follows: Salaries; reimbursement of expenses incurred by its officers and employees in travel and at various stations; apparatus and supplies for the various divisions, their laboratories, the experiment station, and quarantine stations; all accounts of every character that are paid from the appropriation for the Bureau of Animal Industry; the preparation of an itemized report to each Congress, showing in detail the character of expenditures and the use of the appropriation; the making out of all appointments, transfers, promotions, furloughs, reinstatements, resignations, and dismissals; the making of requisitions and informal bids for all materials and supplies used throughout the work of the Bureau, and the necessary letter writing incident thereto, together with the supervision of the work of the animal quarantine stations. This latter work includes the inspection and quarantine of imported cattle, sheep, and other ruminants, and swine, and the making of permits for their importation and keeping the records pertaining to quarantines. The division also has charge of the preparation of replies to numerous letters requesting information in regard to the diseases of animals and poultry, their causes and treatment, and various other matters pertaining to breeds, breeding, and care of domesticated animals, and allied subjects. This is the character of the routine work performed each year.

QUARANTINE OF IMPORTED ANIMALS.

The variety of kinds and the number of ruminants other than cattle and sheep imported during the fiscal year has been increased somewhat through the importations made more especially for exhibit at the Pan-American Exposition. These animals have all been subjected to inspection and quarantine, the length of the quarantine period being fixed in accordance with the requirements for the subdivision of the class to which the animal belonged.

The imports of animals from Canada not subject to detention at quarantine stations comprised 39,572 cattle, 199,325 sheep, 3,227 horses, 435 hogs, 1 goat, 7 deer, and 3 elks; total, 242,570 animals.

The following table shows the number and kinds of animals detained in quarantine for the requisite time.

Number of animals imported and quarantined at different stations, fiscal year 1901.

Stations.	Cattle.	Sheep.	Hogs.
Littleton, Mass	11	128	7
Garfield, N. J	359	270	66
Port Huron, Mich	11	....	....
Detroit, Mich	5	....	....
Sault Ste. Marie, Mich	31	....	2
Ogdensburg, N. Y	3	....	1
Hogansburg, N. Y	6	....	2
Messina, N. Y	4	....	....
Buffalo, N. Y	7	....	....
Niagara Falls, N. Y	3	....	....
Rickford, Vt	10	....	1
St. Albans, Vt	2	....	....
Newport, Vt	16	14	....
Island Pond, Vt	....	3	....
Beecher Falls, Vt	33	10	....
Houlton, Me	55	73	2
Vanceboro, Me	1	17	....
Eastport and Calais, Me	2	10	....
Total	559	525	81

There were also imported through the port of New York and quarantined, under the supervision of the superintendent of the Garfield quarantine station, the following: Antelopes, 4; buffalo, 4; giraffe, 1; guanacos, 2; aoudads, 2; nilgaus, 2; camels, 16; goats, 9; alpacas, 2; chamois, 1; deer, 37; zebu, 1; llamas, 9; gazelles, 3; trick bull, 1; other wild animals, 24—total, 118. Add to this the animals reported in the table above, we have a total of 1,283 imported animals that were quarantined.

An official veterinarian was stationed at London, England, in accordance with the requirements of Bureau of Animal Industry order No. 79, issued by this Department under date of November 10, 1900, which provides for the testing with tuberculin by an inspector of this Department of all cattle over six months old which are to be imported into the United States. This official has tested, in various parts of Great Britain, 161 cattle, for which a permit was desired for shipment to the United States. Of these, 18 were rejected and 143 passed. In Canada the veterinarians of this Department tested with tuberculin 491 cattle, of which 39 were rejected and 452 passed.

OUTBREAK OF MALADIE DU COÏT.

During the last quarter of the fiscal year the work of eradicating an imported infectious venereal disease of horses known as maladie du coït, or dourine, was inaugurated, but owing to the extent of area and the semiwild condition of much of the country over which the disease had spread, as comprised in the Rosebud and Pine Ridge Indian agencies, South Dakota, and parts of Nebraska and Wyoming, little was accomplished beyond the organization of the work. A large number of range horses were rounded up, corralled, and inspected previous to July 1, among which 12 were found to be affected with the disease. These, comprising 2 stallions and 10 mares, were appraised through agreement with the owners and subsequently slaughtered.

Animals found diseased with maladie du coït and killed, and amount of indemnity paid.

Animal.	Owner.	State.	Indemnity.
Stallion	C. W. Denton	Nebraska	$25.00
Mare	S. Chamberlain	Nebraska	20.00
Mare	William Shannon	Nebraska	35.00
Mare	William Shannon	Nebraska	35.00
Stallion	A. A. Lamb	South Dakota	35.00
Mare	P. H. Beguin	Nebraska	10.00
Mare	A. Williams	Nebraska	20.00
Mare	Plenty Birds	South Dakota	20.00
Mare	C. R. Wolfenden	South Dakota	25.00
Mare	L. B. Lessert	South Dakota	30.00
Mare	J. H. Dixon	South Dakota	30.00
Mare	J. H. Dixon	South Dakota	30.00
Total			315.00

The following outline of a report received from Dr. W. S. Devoe, the inspector in charge of this work, exhibits its character:

PINE RIDGE AGENCY,
South Dakota, June 4, 1901.

There are five districts on this reservation—Wakpamini, White Clay, Porcupine, Wounded Knee, and Medicine Root. The animals are rounded up in each district and driven to the final round-up at Pass Creek district, 47 miles from the agency, and then animals which have estrayed from one district to the other during the year are returned, and animals straying in from sections of the country covering 100 miles in area through Nebraska and South Dakota are claimed by owners and removed by them. At the round-up there were present at least 300 men from different sections—horse buyers from Iowa and Omaha, as well as breeders from Nebraska and South Dakota.

On finding a sorrel mare which was badly diseased, I asked the name of the owner, but no one would acknowledge the ownership of the animal. It was reported by men who knew the brand that she came from the sand hills southeast of Gordon, Nebr. I assumed the responsibility in case a claim was made for indemnity, killed the mare, and made a postmortem examination to give those present an opportunity to learn more of the nature of the disease. The lesions of maladie du coït were very pronounced.

It was the desire of the breeders and owners of the horses present that the other diseased animals found should be killed on the spot, but not knowing who the owners were and wishing to show the people of this section the disease in its various stages, they were removed to the agency.

Several diseased animals have been slaughtered without indemnity, as they were unclaimed.

BIOCHEMIC DIVISION.

ROUTINE WORK.

The routine work of preparing and shipping branding ink, tuberculin, and mallein has been continued as heretofore. This division has shipped about 560 gallons of branding ink for use in marking inspected meats, 44,410 doses of tuberculin, and 7,188 doses of mallein. The routine work in connection with serum experiments, hog cholera, and swine plague have been continued. A large number of herds were treated in the West during the summer and fall of 1900 and the spring of 1901, and the work is being continued at the present time. In general, the results have been of an encouraging character. At the same time, in some herds other factors have arisen for consideration, which have been and are now being investigated with the hope of throwing additional light on the methods of handling these troublesome diseases.

All this work has entailed a large amount of routine work in the preparation of cultures for the inoculation of animals, in the preparation of serum, and especially in the identification of cultures obtained from herds in the West which have been under treatment. In the progress of this work a number of new varieties of bacilli belonging to the hog-cholera group have been isolated, and other important properties and variations have been carefully studied.

LABORATORY WORK IN TUBERCULOSIS.

The work in connection with tuberculosis has been continued. A number of germs from different species of animals have been secured and cultures made with the purpose in view of obtaining sufficient material for continuing the biochemical and other investigations already begun. The experiments with the serum for tuberculosis in the human being have also been continued at one of the sanatoriums in New York, and the results, as reported by the physician in charge, are of a very encouraging character. Some feeding experiments on chickens have also been conducted during the year and the results are about ready for publication. A number of routine analyses and examinations have been made as the work demanded. A large number of investigations in connection with tuberculosis, in addition to those already named, have been begun, and special attention will be given to the injury to man from bovine, or rather animal, tuberculosis.

There has been some investigation in connection with milk, and arrangements have been made for a careful study of the bacteriologic and biochemic factors in the production of flavor in butter and cheese. This work will be continued as soon as possible.

Investigations along the lines indicated above will necessarily be continued during the coming year, and other subjects will be taken up as the facilities of the division will permit.

PATHOLOGICAL DIVISION.

The work of the Pathological Division has been continued along the same lines as during the previous year, with the exception that increased facilities have made it possible to devote more time to the investigation of pathological anatomy. The number of specimens received from the members of the Inspection Division of this Bureau, as well as from outside parties, have increased by more than 200 per cent over that of any previous year.

BLACKLEG.

The preparation and distribution of blackleg vaccine have, with the increased experience of the assistants detailed to this work, become more of a matter of routine, without sacrificing any of the care and attention which this line of the work demands.

During the fiscal year there were prepared 1,582,625 doses of blackleg vaccine, and of this amount approximately 42,000 doses were discarded as not meeting the requirements for vaccine that is both safe and effective. There were distributed 1,517,560 doses among 12,013 cattle owners. This is an increase of more than 50 per cent over the previous year, when the total number of doses sent out was 1,076,150. The work in this connection has necessitated the preparation and sending of 30,490 pieces of mail, as well as the filing and tabulation of approximately the same number of letters and reports; also the writing and filing of about 20,000 cards for the personal and geographic card catalogue.

From reports received, it is safe to conclude that the loss from blackleg in all herds where this vaccine has been used will fall below 1 per cent, although it is the general impression that the past year has been what is known as a "bad blackleg year" throughout the entire country. It is gathered from information received from all States and Territories that without vaccination the loss from blackleg would have been greatly in excess of that which is generally experienced. The expenses in connection with the preparation and distribution of this vaccine have not exceeded those of the previous year, when only 1,076,150 doses were distributed.

RABIES.

From numerous reports received from various parts of this country it appears that rabies is greatly on the increase among dogs and other domesticated animals. While there has been a decrease in the number of cases of rabies actually proved to have occurred in the District of Columbia, losses from this disease have been general among the horses, cattle, sheep, and hogs in Virginia and some of the Western States, notably Colorado and Missouri, as a result of bites from rabid dogs and wolves.

An outbreak of rabies among the dogs at Rochester, N. Y., in which at least one authentic case of rabies in man occurred, necessitated stringent measures by the city health authorities in order to suppress the outbreak. Inoculation experiments at this laboratory proved conclusively that the person mentioned had died of rabies, and also that one of the dogs, the head of which was forwarded from Rochester, was suffering with this disease at the time of its death.

In the stock yards of St. Joseph, Mo., the disease appeared among a shipment of cows which were known to have been bitten some time previously by a rabid dog, and which were held at the stock yards for observation. Four of these animals died with symptoms of furious rabies, and the diagnosis was confirmed by inoculation experiments made in this laboratory. Further investigations proved that a number of other domesticated animals had died, with characteristic symptoms of rabies, in the neighborhood from which the cows were shipped.

From the District of Columbia there were received 60 dogs which had been killed as being suspected of rabies. Of these, 15 were proved to have been affected with the disease at the time of their death. It is known that 5 of these dogs had bitten one or more people. These people were notified of the results of the inoculation experiments, in order that they might take the necessary precautions to prevent the development of the disease. Three of these dogs were also known to have bitten cattle, horses, or other dogs.

The health authorities of the District of Columbia also forwarded the dead bodies of 2 cats, 1 of which proved to have been affected with rabies.

TUBERCULOSIS.

Experiments for the eradication of tuberculosis from the dairy herd at the insane asylum at St. Elizabeth, District of Columbia, have been continued, and all the reacting animals have, by this time, been destroyed and replaced with tuberculin-tested cows. The new herd, now consisting of 115 milch cows, will shortly be submitted to a final test in order to ascertain whether any of the purchased animals have developed tuberculosis since they were admitted to the barns of the asylum.

Inoculations on guinea pigs with milk from the reacting cows, in order to test its infectiveness, have developed results of such a nature that it has been considered advisable to repeat them on a smaller scale before the results are published. It may, however, be mentioned that the results are strongly indicative of the frequent occurrence of tubercle bacilli in the milk of cows which have reacted to the tuberculin test, but which do not show clinical symptoms of the disease.

EXAMINATION AND DIAGNOSES OF PATHOLOGICAL SPECIMENS.

In the course of meat inspection, as carried out by the Bureau of Animal Industry, it frequently occurs that inspectors encounter pathological conditions which even the most trained eye fails to recognize. In a majority of cases the inspectors have neither facilities nor time for histological or bacteriological investigations, and it has, therefore, become customary to forward rare or interesting pathological specimens to this division for diagnosis or for confirmation of diagnoses made by the collectors. During the past fiscal year no less than 344 such pathological specimens were received at this division, and the great majority of these were collected and forwarded by members of the Inspection Division. In all cases where possible the specimens were treated and preserved according to Kaiserling's method, and the anatomical preparations were added to the pathological collection of this division. At the same time the various tissues were hardened, sectioned, stained, and mounted, and the collector notified of the diagnosis made upon microscopical examination. In this manner more than 2,000 permanent preparations have been made and preserved for future reference.

A great number of pen-and-ink as well as water-color sketches have also been made of the anatomical as well as the histological appearances of the specimens, for the purpose of publication with a series of notes upon comparative pathology with special reference to meat inspection. A great deal of this material is now on hand and will be 'ished with as little delay as possible.

DISEASES OF POULTRY.

Of all the various classes of domesticated animals, there is probably none which suffer to the same extent from infectious and contagious diseases as do the domesticated fowls. A number of diseased or dead fowls were received during the past year for diagnosis and advice as to treatment and prevention. An outbreak of an acute and very fatal disease among a large flock of thoroughbred Plymouth Rocks, in northern Virginia, is of special interest. As the disease differed from all those hitherto described, a thorough investigation was made both at the premises where the outbreak occurred and in this laboratory, and a bulletin containing the preliminary notes on an outbreak of apoplectiform septicemia in chickens, caused by a highly virulent nonpyogenic streptococcus, has been prepared and is now ready for publication.

All the other specimens forwarded were recognized as originating from outbreaks of diseases, the nature and cause of which are more or less well established, and the owners were furnished with information as to the proper means of treatment and prevention.

Under this heading may also be mentioned an epidemic eye disease which prevailed among the crows in the District of Columbia and surrounding country during the past winter. In certain localities great numbers of crows were found dead or dying, all of them exhibiting symptoms of suppurative keratitis and conjunctivitis. An investigation led to the discovery of a small microorganism as the probable cause of this disease, but, on account of failure to obtain healthy crows for experimental purposes, the investigation was not brought to a satisfactory conclusion.

SKIN DISEASE IN HORSES.

During February last attention was called to a skin disease prevailing among the horses on the Umatilla Indian Reservation at Pendleton, Oreg., and specimens of hide of the affected animals were forwarded to this division for diagnosis. As several thousand horses were said to be affected with this disease, it was of importance that a diagnosis be made, and means suggested for its eradication. The probable causative agent was found to be *Sarcoptes* complicated by the presence of a vegetable fungus which has never hitherto been known to possess pathogenic properties. A bulletin has been prepared on the subject and will be published at the conclusion of a series of experiments which are now being undertaken with a view to finding a remedy for the disease.

LOCUST FUNGUS.

During the past year the Division of Entomology has undertaken a series of experiments for the eradication of locusts by means of fungus cultures, with which the swarms of locusts are inoculated. This division has cooperated in this work by preparing more than 200 tubes of these cultures for the division mentioned.

GLANDERS.

It has devolved upon this division to prove or disprove, by means of inoculation experiments, the diagnosis of glanders among the horses and mules of the War Department which are stationed at St. Asaph, Va., after they have been submitted to the mallein test. In all cases where decided reaction has occurred, the diagnosis has been confirmed, and the same has been the case with a number of mules which showed a doubtful reaction. Material from an outbreak of glanders near Ames, Iowa, was also referred to this division and the diagnosis confirmed.

FIELD INVESTIGATIONS.

Salt-sick among the cattle in Florida.—During April last an attempt was made to investigate a disease known as salt-sick, or salt-sickness, which is reported to prevail to a considerable extent among the cattle of central and eastern Florida. The time selected was, however, inopportune and no typical specimens of the disease were obtained for examination. From the information gathered it seems probable that the disease is chronic Texas fever, aggravated by malnutrition and tick-worry. If, however, another opportunity presents itself the investigation will be continued this coming winter.

Spinal meningitis.—A number of outbreaks of this disease have been reported from eastern Maryland and Virginia, and in three cases an inspector from this division was sent to the infected districts in response to urgent requests. In no case has it been possible, however, to obtain typical cases for investigation, as the animals affected had either died or recovered by the time the inspector arrived.

THE EXPERIMENT STATION OF THE BUREAU.

HOG-CHOLERA AND SWINE-PLAGUE SERUM.

The investigations concerning swine diseases, which have been conducted at the Experiment Station for several years, were continued throughout the year. Fully as much attention was given to the preparation of an antitoxic blood serum for the treatment and prevention of hog cholera and swine plague, as in former years, and some progress was made in reducing the price for which the serum can be manufactured.

EXPERIMENTS IN IMMUNIZING AGAINST HOG CHOLERA AND SWINE PLAGUE.

In addition to the serum work, extensive experiments were made to find a method for immunizing against hog cholera and swine plague without the use of an antitoxin animal. This work has not yet given satisfactory results, but further experiments with this end in view have been planned. One of the great obstacles encountered in these investigations is the uncertainty with which a proper exposure can be obtained for treated hogs and accompanying control animals. Subcutaneous injections of apparently virulent pure cultures of hog-cholera and swine-plague germs rarely produce anything more than a local inflammatory condition. Attempts to produce disease by feeding the viscera of hogs which have died of hog cholera or swine plague have failed in all but one instance in our recent work at the station, and, in the case of the exception, the disease was of a very mild chronic character. It is quite possible to kill hogs by injecting cultures directly into their circulation; but by this method death is caused rather by a toxemic overpowering of the entire organism than by an affection at all resembling hog cholera or swine plague, and hence it is questionable whether it can be used advisedly as a test for any system of immunization.

TETANUS.

No cases of tetanus occurred at the station during the year. The antitetanic serum which is prepared at the station is regularly and successfully used to immunize all the animals which, owing to their condition and the work in which they are engaged, are liable to become affected with tetanus. The two horses which supply the serum have gradually been worked up to a state where the one can bear 1,200 cubic centimeters and the other 1,550 cubic centimeters of tetanus toxin at a single injection. This toxin is so virulent that a fraction of a drop on subcutaneous injection kills a guinea pig within twenty-four hours. The antitetanic serum will be tested for its curative value as soon as an opportunity presents itself.

A peculiar effect of the tetanic serum, when used in immunizing doses, has been observed on some cattle. These cattle, within an hour after receiving an injection of from 10 to 15 cubic centimeters of the serum, begin to show edematous enlargements about the eyes, lips, nose, vulva, and rectum. The parts at times swell enormously. The intensely stretched skin over the vulva and rectum assumes a glistening appearance and looks as if the extreme tension would cause a rupture. At times the skin of the neck and abdomen is also affected and is covered with elevations resembling the appearance present in urticaria, or nettle rash. The symptoms disappear after ten or twelve hours, and the recovery of the animal is complete. An effort has been made to determine whether the swelling is due to the antitoxin of tetanus or to something normally present in the blood serum of the horses. The question has not been finally settled, and will receive more attention in the future.

TEXAS FEVER AND TICKS.

Several minor investigations concerning Texas fever were undertaken and are still in progress. Along with other work of this kind a number of ticks were secured, through the Division of Zoology, from different countries which are plagued with ticks and a disease similar to or identical with Texas fever. These ticks from Egypt, Cape Colony, Brazil, Australia, and the West Indies are now being cultivated to obtain good specimens for study and comparison with the North American tick, which acts as the transmitting agent of the infectious material of Texas fever.

Little or no progress has been made in the search for a reliable dip to destroy ticks on cattle. A number of new dips have been tested and found unsatisfactory. Reports from several sources indicate that the ticks can be affected by substances given internally to the cattle on which they are parasitic, but tests of such substances have given no encouraging results at this station. This entire question will receive further attention in the future.

Toward the end of last summer the cattle ticks in the tick fields had become so numerous that it was necessary to spray the fences and adjoining ground every few days, and even with this precaution the cattle in the fields near the tick fields could not be kept altogether clean. In some instances the young ticks crawled from 20 to 30 feet along the ground and up the sides of fences and buildings, where they collected in clumps of several thousands each. Ticks from these clumps in elevated positions could easily be blown considerable distances by moderately strong winds. The solution used for spraying consisted of tar, carbonate of soda, arsenic, and water. It was very effective in destroying the young ticks which had not become attached to a host, but it killed less than 75 per cent of the ticks of all sizes on the cattle which were dipped in it.

An interesting occurrence in connection with the tick experiments was the accidental presence of the parasites on two kittens which were confined in a small house in the tick field. The house also contained a number of guinea pigs, which remained perfectly clean. The ticks developed very slowly on the kittens, and the latter unfortunately died before any of the ticks matured. The extreme irritation of the skin and the loss of blood were largely responsible for the death of the kittens.

EXPERIMENTS WITH RABIES.

A number of animals reported to have been bitten by rabid dogs were received at the station, and were kept in confinement and under observation.

Several experiments regarding rabies were made in conjunction with the Pathological Division. One horse which was bitten and some sheep which were inoculated with material from rabid animals succumbed to the affection after showing characteristic symptoms.

OTHER WORK.

Some work was done in connection with the antitoxin experiment to determine the loss in the number of red-blood corpuscles as the result of frequent blood drawings, and the rapidity with which the animal's system is able to correct the loss by the formation of new corpuscles. Time was also given to a study of the character of the newly formed corpuscles, and to the possible modifications in the number and character of the white corpuscles of animals which receive periodic injections of septic material. Investigations along this line will be continued as time will permit.

Animals and facilities were provided the Division of Zoology for the further investigation of the sheep-scab question, and to test various drugs for the removal of parasites from the stomachs and intestines of sheep and hogs.

The Pathological Division was provided with animals and facilities for the investigation of the following diseases: Braxy and pseudo-tuberculosis in sheep, vulvitis of cattle, and an infectious disease among the cattle of a local asylum. A number of specimens of black-leg vaccine were also tested for the same division on sheep and guinea pigs.

Cattle and hogs were provided for the Biochemic Division for special experiments concerning hog diseases, and these animals were treated with material prepared by the division in accordance with instructions accompanying such material.

As in former years, a large number of small animals for experiment purposes were raised at the station and used or forwarded to the laboratories as occasion required.

Several new buildings were constructed, much necessary fencing and refencing was done, and the water system improved and extended. A fairly successful attempt was made to raise a supply of green feed for small experiment and breeding animals. Work of this kind makes excellent returns for the time and thought given to it, and it is to be regretted that the area of ground which is available for cultivation is limited to less than 1 acre.

The need for additional land is constantly and urgently felt. On a total of 20 acres, much of which is occupied by buildings, roadways, outdoor experiment cages and quarantine pens, the following animals, employed in widely different experiments, together with the facilities for handling them and keeping the various infections under proper control, are collected:

(1) A herd of 72 antitoxin animals, consisting of horses, mules, cattle, and donkeys, for supplying hog-cholera, swine-plague, tetanus, and two kinds of tubercular serum.

(2) Several animals, a horse, cattle, and donkeys, for supplying normal serum for a variety of purposes.

(3) A herd of a dozen or more cattle either affected with tuberculosis or being employed in experiments concerning this disease.

(4) A flock of 50 or more sheep, subjects of investigations concerning sheep scab, foot rot, blackleg, pseudotuberculosis, true tuberculosis, and various internal animal parasites.

(5) Half a dozen cattle used in Texas-fever investigations.

(6) Cattle on which at least half a dozen different varieties of ticks are being grown, all of which must be kept well separated and under conditions which will prevent the ticks from getting on any animals except those which are intentionally infected.

(7) A small herd of cattle used in tick-dipping experiments.

(8) About a hundred hogs, in special hog-cholera and swine-plague experiments, in which at least a dozen different bacteria, supposedly pathogenic, are being handled.

(9) Dogs in quarantine and under observation for rabies.

(10) Horses affected with maladie du coït.

(11) Goats in special milk work.

(12) Donkeys, hogs, calves, and monkeys, and several kinds of smaller animals in special tuberculosis investigations.

(13) A collection of brood sows, for producing young pigs for special swine-disease investigations.

(14) A number of normal work horses.

Our fields are so small for the animals confined in them that they remain bare of vegetation the entire year and present the appearance of a desert.

DAIRY DIVISION.

A general survey of the condition of the dairy industry of the country at large was begun upon the organization of the Dairy Division. This has been continued and special inquiries have been made, such as the status of dairy organizations, dairy schools and facilities for technical instruction, State dairy laws, the development of foreign markets for the dairy products of this country, the milk supply of cities and towns, and laws and ordinances relating thereto. Some reports have been printed and others are in course of preparation.

As heretofore, attention is given to the collection of dairy data in general, with a view to its proper arrangement and future use. So far as the clerical force of the office permits, the material collected has been indexed for ready reference. Although necessarily much in arrears, this catalogue of dairy information is of great value and in constant use.

The routine work of the office is constantly increasing. This embraces current correspondence, with many requests for specific information from all parts of the country, and the preparation of reports and other manuscripts for publication. During the year the division has prepared four distinct publications for distribution, comprising in all 188 printed pages; most of these were liberally illustrated from original photographs obtained for the division or made by its officers. One of these reports was published in the Yearbook for 1900 and two in the current Annual Report of the Bureau, all being separately reprinted.

The chief and assistant chief of the division have visited dairy centers in ten different States and attended conventions of dairy associations and similar bodies in four of these. Rather less has been done along this line than in previous years—first, because of discontinuing the plan of employing persons for this representative service who are not regularly connected with the Department, and, second, because of the time occupied in giving attention to more distant fields of interest.

The new insular possessions of the United States and thirteen foreign countries have been visited during the year by officers or special expert agents of the division. The investigations thus made have embraced the most interesting dairy producing districts of Great Britain and western Europe and the markets of Japan, China, Canada, Cuba, and St. Thomas. Materials have been thus collected for special reports now in preparation and others to be made later.

Experimental exports of dairy products from the United States, similar to those of previous years, have been made to Great Britain, to France (in connection with the Paris Exposition), to Japan, China, Cuba, and Porto Rico. It has been well established that our market for cheese in England and Scotland can be largely and profitably increased by judicious management. Butter from this country can find a place in the British markets at almost any time in successful competition with the best product of other countries, provided our surplus production affords a regular supply and the prices offered become a sufficient inducement to exporters. Occasionally at irregular periods, and owing to special and temporary conditions, American butter can be sold to advantage at Hamburg and at Paris. No other market has developed on the Continent of Europe favorable for butter from the United States. In Cuba, Porto Rico, and other points in the West Indies there are opportunities for increasing the sales of dairy products from this country. A special report upon this subject will soon be submitted. In Japan and China some openings for new trade are being found, but active Australian competition must be met. It is rather too early to express definite opinions on this subject, but it now appears necessary to raise the quality of Pacific coast products, improve methods of packing and preserving, and obtain more satisfactory ocean transportation facilities before any considerable demand can be created in the Orient for the dairy products of the Pacific States.

Incidental to the experimental exports, fine exhibits of dairy products of the United States were made at the Universal Exposition at Paris and the annual show of the British Dairy Farmers' Association at London (October, 1900). These displays were personally supervised by the chief of the Dairy Division, and the duties connected therewith required much labor of detail at the office of the division. A report upon the dairy features of the Paris Exposition has already been submitted and published.

During the fiscal year 1901-02 the work of the Dairy Division is expected to be largely a continuation of that of the year previous, as above reported.

The investigations of productive conditions, demands of consumption and markets, made in Porto Rico and other West Indian islands by Mr. Pearson, assistant chief of the division, and in the Orient by Mr. Emery, special expert agent, will be completed and reported upon. Further experimental exports are likely to be made, based upon these reports.

Incidental to these endeavors to supply butter and cheese to markets in warm climates, and requiring long voyages without refrigerated transportation, it will probably be found necessary to make a careful study of the whole subject of preparing and packing butter for distant markets and long keeping, with exposures to high temperatures. In the same connection, further investigation of the means of producing good butter having a high melting point and comparatively resistant to high temperature in transit and in market is necessary.

More attention is being given every year in this country to the manufacture of cheese of foreign forms and peculiarities. Information on this subject is called for and another field of labor for the division is thus indicated.

Material improvements are in progress in the milk supply of cities and towns. The Dairy Division hopes to follow this important subject closely, and to contribute to the means and methods of attaining the desired advance in the purity and quality of market milk.

In accordance with repeated recommendations from this office, approved and embodied in successive Annual Reports of the Bureau and the Department, the Congress at its last session amended the act of 1891, which provides for the inspection of live cattle, the carcasses and products thereof, to include all dairy products offered for export, in order "to secure their identity and make known in the markets of foreign countries to which they may be sent from the United States their purity, quality, and grade." This new law becomes operative with the beginning of the fiscal year of 1901-02, and it is assumed that considerable work of administration and supervision will devolve upon the Dairy Division in this connection.

As collateral to the work of this division it is hoped to conduct during the year a very full analytical examination of the various dairy products of foreign countries. Samples for this purpose have already been collected and will be greatly added to from the products found
ficers and agents of the division at the foreign exhibitions and
visited.

Some cooperative labor will be expected of the division in the course of the year under the arrangements already made with the Census Bureau for criticising and verifying the statistics of dairying in the Twelfth Census of the United States.

THE ANGORA GOAT INDUSTRY.

During the last three or four years requests for information about Angora goats have been received in increasing numbers. These requests finally became so numerous that a bulletin was issued on the subject under the title of "Information concerning the Angora goat." This bulletin contains 94 pages, 17 plates, and 1 text figure, and was designed to give answers to all the questions that are asked of the Bureau. But the demand for it was great and stimulated a desire for further information, especially regarding available land and names of breeders and dealers in mohair, subjects which could not properly be discussed in the bulletin. This has operated to increase rather than diminish the correspondence.

Angora goat raising is in fact a rediscovered industry in the United States. For a score or more of years these goats have been raised in large numbers in Texas, New Mexico, California, and Nevada, and there has always been a ready market for their mohair; but it is only quite recently that their ability to clear land of brush, briers, and weeds has become generally known throughout the country. Now that the fact is well known, there has been a great demand for these goats in those sections of the country which are suffering from the encroachment of brush and briers upon the farm and pasture lands. They have found their way into every State in the Union, as well as into Canada and Alaska.

Assured as we are that the Angora will produce an annual fleece which is worth from $1 to $1.50; that it will destroy the brush, briers, and weeds on abandoned land, permitting the grass to follow; that its flesh is as palatable and as nutritious as that of the sheep; that its skin with the fleece attached is worth from $1.50 to $2.50—it would seem that Angora goat raising is certain to develop into a permanent industry.

A Farmers' Bulletin on "The Angora goat" will soon be issued, besides the bulletin mentioned above, and the Bureau will from time to time publish such additional information as may come to hand.

EXHIBIT AT THE PAN-AMERICAN EXPOSITION.

The duty of suitably representing the work of the Bureau of Animal Industry at the Pan-American Exposition at Buffalo, May–November, 1901, was intrusted to Mr. E. B. Jones, assistant chief of the Inspection Division. Although the space and amount of money allotted to the Bureau were both inadequate, a comprehensive display of the various branches of its work was made. The idea was to show, as well as the means permitted, what the Bureau is doing, both scientifically and practically, for the benefit of the farmer, stock raiser, and consumer of animal products.

A list of the various features comprising its exhibit, prepared for the use of the officials of the exposition, gives a condensed description, and is printed here in preference to a more detailed statement. A complete list of the titles of every article shown would be superfluous.

Series 1 illustrates the meat-inspection work of the Bureau.

(*a*) Practical demonstration of the microscopic inspection of pork for trichinæ. Three assistant microscopists are engaged in examining samples of pork from one of the official abattoirs. A specimen of pork containing trichinæ is under a microscope arranged for the inspection of visitors.
(*b*) Plaster life-size models of a half of a beef carcass, a carcass of mutton, and a hog carcass to show how they are branded after having been inspected and passed as wholesome.
(*c*) Articles used in the inspection of meat and live animals, such as tags, brands, seals, sealing presses, stamps, certificates, sample boxes, compressors, etc.
(*d*) Photographs of the antemortem and postmortem inspection of cattle.

Series 2 illustrates how cattle are inspected and tagged prior to exportation, the manner of loading animals upon the vessels, and the way in which vessels are fitted to secure the safe and comfortable transport of animals to foreign countries.

(*a*) Model of part of stock yards, showing the employees of the Bureau of Animal Industry engaged in inspecting and tagging cattle for export.
(*b*) Model of section of cattle-carrying steamer and pier and stock car. This shows how cattle are loaded from cars into steamers and how they are stowed on board, and the character of the fittings required on vessels engaged in the cattle-carrying trade.
(*c*) Photographs showing the inspection and tagging of cattle for export, the loading of a steamer with cattle and horses, and views of the decks to show the fittings on a modern cattle steamer.

Series 3 illustrates the cause and appearance of the disease known as sheep scab or scabies in sheep, and the spread of which is largely prevented by dipping in a preparation which kills the parasite. The method of dipping is well shown by models and photographs.

(*a*) Models of sheep-dipping plants, showing how sheep are dipped for the prevention of scabies. Two forms of vat are illustrated.
(*b*) Two mounted sheep, illustrating the effects of scabies, one in the early stages of the disease, the other in a more advanced condition.
(*c*) Two wax models, greatly enlarged, of the male and female parasite causing the disease of scabies in sheep.
(*d*) Photographs of sheep-dipping scenes.

Series 4 gives photographs of Angora goats: Views of individuals and groups, pasturage, effect of "goating" on brush land, degrees of fineness in mohair, etc.

Series 5 refers to Texas-fever work.

(*a*) Calfskin, to which are affixed wax models of the Texas-fever tick. This is to show the appearance of the tick and the way in which they attach themselves to cattle, selecting the more tender and protected parts on the under side of the body.

(*b*) Maps showing the part of the United States infected with Texas, or splenetic, fever in cattle, one map containing the entire area, others showing sections on a larger scale.

Series 6 is a very complete exhibit of the horse's leg, foot, and shoe—the anatomy of the leg and foot; samples of feet, illustrating various abnormal conditions affecting them; the result of improper shoeing; how to correct abnormalities by using proper methods of shoeing; various kinds of shoes, and horseshoeing tools.

Series 7 illustrates the work of the laboratories of the Bureau of Animal Industry in the investigation of the causes and means of prevention of animal diseases.

(*a*) Working laboratory fitted with all the necessary apparatus for investigations in pathology, bacteriology, and zoology.

(*b*) Model of chute used for vaccinating calves against blackleg, and also for dehorning them.

Blackleg virus and vaccine.

(*c*) Plaster and wax models of diseased animal organs, to illustrate the lesions found in various diseases.

(*d*) Specimens of tissues and organs in preserving fluid, showing the lesions of different diseases affecting animals.

(*e*) Cultures of pathogenic bacteria.

(*f*) Specimens of animal parasites, preserved in alcohol.

(*g*) Products of bacteria, toxins, and antitoxins, mallein and tuberculin.

(*h*) Case of 60 transparent photographs, showing tissues and organs affected with various diseases, magnifications of slide preparations of pathogenic microorganisms, and enlarged views of animal parasites.

Series 8 illustrates the dairy exhibit.

(*a*) Composition of milk and its products; one gallon of milk and its component parts; one tub of butter (10 pounds) and its component parts; one cheese (10 pounds) and its component parts.

(*b*) Samples of the commercial forms of the by-products of the dairy, and articles showing their application.

Casein, albumen, and milk sugar, with their commercial forms and applications, illustrative of the economic uses of the by-products of dairying.

"Nutrium," the nonfatty solids of milk, in a pure, dry, imperishable form, but soluble and digestible, for use as a human food, and especially in baking and bakery products, illustrative of the economic uses of the by-products of dairying.

(*c*) A complete collection of modern cans, models, bottles, buckets, brushes, etc., both domestic and foreign, which are essential to clean dairying.

A large collection of milk cans and dairy hardware, good material and workmanship, with consequent efficiency and durability.

Models and material illustrative of methods and appliances for a pure, sanitary milk supply.

(*d*) General collection of commercial packages for milk and butter, of most approved forms, in use in the United States and foreign countries, showing advancement of the market features of the dairy industry.

(*e*) Collection of 34 models illustrating foreign forms of cheese.

(*f*) Photographs of model dairies.

EMERGENCY REPORT ON SURRA.[a]

By D. E. SALMON, D. V. M.,
Chief of Bureau of Animal Industry,
AND
CH. WARDELL STILES, PH. D.,
Pathologist of Bureau of Animal Industry.

SUMMARY.

Surra has been diagnosed among the horses in the Philippines, and has led to the prohibition of landing any animals from those islands at any ports of the United States or of the dependencies thereof.

This disease is caused by a microscopic parasite (*Trypanosoma Evansi*) which lives in the blood, and the evidence now accessible indicates that this organism is transmitted by means of biting flies, especially by members of the genus *Tabanus* (horseflies); other methods of dissemination are not excluded. It is chiefly a wet-weather disease, and is reported as invariably fatal to horses and mules. It occurs in other animals—such as camels, elephants, dogs, cats, etc.—more rarely in ruminants, and may be transmitted to goats, sheep, and other mammals, but is not yet reported for birds. It is more or less common in India. Its introduction into the Philippines is unexplained, but it has probably existed there for some years past.

Parasites closely allied to this species occur in Europe, Africa, and South America, in some cases causing diseases known as tsetse-fly disease, dourine, mal de caderas, and rat trypanosomiasis. Certain authors believe that some of these maladies are identical with surra.

The chief symptoms of surra are fever, of an intermittent, remittent, and sometimes relapsing type; urticarial eruption; petechiæ on the mucous membranes; progressive anemia and emaciation; ravenous appetite and extreme thirst; more or less paralysis.

Treatment has not been satisfactory, but arsenic has been followed by good results in some cases. Prevention is difficult, but should consist in protecting horses from flies. Immediate isolation of the sick animals and protecting them from flies will result in restricting the disease. In some cases it will perhaps be better to kill and immediately destroy the diseased animals.

From both the military and the economic points of view surra must be looked upon as a very serious matter, and its introduction into the United States would result in very heavy losses.

INTRODUCTION.

ORIGIN OF THE PRESENT REPORT.

A cablegram from Major-General Chaffee, Manila, P. I., asking for information regarding surra, has been referred to this Bureau. This dispatch reached us simultaneously with a preliminary report on a parasitic disease prepared by Dr. John G. Slee, formerly an inspector of this Bureau, so that we conclude that since the report was mailed the diagnosis of surra has been made. Dr. Slee's letter reads as follows:

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[a] Appeared also in Bulletin No. 42, Bureau of Animal Industry, U. S. Dept. Agric., Wash., pp. 11-130, figs. 1-112.

Office of the Insular Board of Health for the Philippines,
Manila, P. I., October 24, 1901.

Dear Sir: I inclose a few notes upon a new disease that has appeared in the islands this season among the native and foreign horses (I use the word foreign, as we have American, Australian, and Chinese ponies, in all of which I have noted the trouble). The parasite was first discovered in the blood of a horse taken by myself to the laboratory of the board of health, but for further information and many experiments made I am indebted to Dr. J. J. Kinyoun, United States Marine-Hospital Service.

By a later mail I shall probably be able to give further information, but at present I should like very much to obtain an idea of what we have found, and if you know of a similar parasite—if there is any literature on the subject. Dr. Kinyoun seems to think that it is entirely new.

I am, very respectfully,
John G. Slee, D. V. S.,
Assistant Veterinarian, Board of Health.

Dr. D. E. Salmon,
Chief of Bureau, Washington, D. C.

[Inclosure.]

Notes on a New Disease of Horses.[a]

During the past rainy season a disease of a febrile type affecting the foreign and native horses has been noted by the veterinarians.

The history was at first very obscure, the disease usually being far advanced when first seen, the death rate high, and treatment unsatisfactory.

The resident veterinarians and horse owners had noted the same conditions in former years, which they described as calentura, or fever, but did not think it had been so widely spread or the mortality so large as during the present season. Dr. H. H. Muecke, veterinarian of the Land Transportation Corral, says that he had not noted it during the past two seasons, but he was able to give considerable information concerning the disease as it appeared this season in the Government horses.

That the disease was widespread was evident from the reports to the board of health, and investigation showed it to be generally present in the island of Luzon. In one place all the native horses had died, while of the Government stock about one-half were affected.

The first cases in native horses came under notice about the first part of June, and presented swellings of the sheath, legs, and pads under the belly, in many respects similar to those of purpura; the membranes were colorless, hemorraghic spots were present on the membrana nictitans, but no petechial spots were observed on the Schneiderian membrane, as in purpura. These were not seen in the foreign horses. There was always a temperature, very irregular, from normal at times to 105° F. In the native horses the disease would not run a very long course, anorexia appearing in the final stages, followed by death.

When the horses in the corrals became affected the symptoms could be more easily noted. This was simply due to the fact that the native never notices that an animal is sick until it is past recovery. I have seen horses with a well-advanced case being used.

In the corral the sick animal at first showed a temperature of from 103° to 107° F.; pulse full; breathing increased and abdominal; appetite variable, from poor to good, but never entirely lost; the membranes slightly injected, but no hemorrhagic spots, as noted in the native animal. The swellings of the belly, sheath, and legs soon appear. In some cases they may not be present, emaciation taking the place, but in the native horses swellings seem to be always a marked symptom. At this point the temperature is variable, of an intermittent character, and is not controlled by any of the febrifuges; it may be higher immediately after giving medication than before. Some of the cases last for a long time, being in the hospital for two or three months, and ending in recovery or death. If the swellings suddenly disappear, death soon follows in the native horse; but this is also a symptom of recovery in the foreign horse.

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[a] Same as Slee, 1902a, pp. 819–821.

As the disease progresses toward a fatal termination the animal grows very weak, particularly in his hind legs, weaves from side to side when walking, and may gc down and be unable to rise.

The feces are of a normal character, no marked constipation or diarrhea being present; the urine seems to be increased in quantity, but as to color or changes I have been unable to note particulars.

Postmortem.—No special lesions are found, the organs and tissues showing an anemic condition, but in some cases abscesses were noted in the stomach and abdominal cavity. The pericardial sac and pleural cavity are always full of a serous fluid, but no appearances of inflammatory changes are present; antemortem clots are found in the heart.

As there were so many cases the disease was supposed to be of a contagious type, but this did not seem probable, as in a stable of several horses one would be affected and the others remain healthy, although the horses were standing side by side and eating out of the same manger.

The character of the disease being so much like malarial fever, the infection was looked for from some other source and a parasite in the blood was suspected. Upon the examination of the blood of a well-marked case, an animal parasite was discovered which was also found in all the cases examined. In the new cases the parasites were seen, and as the cases progressed they increased in number, but toward recovery they grew less and finally disappeared.

The parasite is an animal organism, rather blunt at one end, with a flagellum at the other; in advancing the tail seems to advance, becomes entangled with the corpuscles, and it drags itself forward. It can go backward, but the most of its movements are with the tail advancing. They are of different sizes, the smaller seemingly a male, the larger a female. They often come together, the blunt ends being attached and the flagellum moving very rapidly.

That they have some action on the red blood corpuscles is very evident, as the blood count is diminished and the leucocytes increased.

Where the parasite comes from is not known. To learn its life history will probably necessitate examination of the fly and mosquito, for the disease is widespread, and the affected animals are fed and watered in so many ways (the Filipino depending upon grass and rice, while the Government stock have hay and oats), that this would in a measure exclude feeding as a source of infection.

After the present report was nearly completed, we received, through the courtesy of Dr. George M. Sternberg, Surgeon-General, United States Army, the following report by Drs. Allen M. Smith and J. J. Kinyoun, dated Manila, October 17, 1901:

A PRELIMINARY NOTE ON A PARASITIC DISEASE OF HORSES.[a]

By ALLEN M. SMITH, *Captain, Assistant Surgeon, U. S. A.*, and J. J. KINYOUN, *Surgeon, U. S. Marine-Hospital Service.*

On October 15, 1901, information was given us by J. W. Jobling, assistant bacteriologist of the board of health at Manila, that an epidemic sickness of an undetermined nature was now prevailing in this city, and also that he had just taken a specimen of the blood from a sick animal which on examination revealed the presence of a parasite. Whether this was accidental or was the causative agent of the disease in question, he was unable to say. On investigation and inquiry, it was learned from the veterinarian in charge of the corral of the quartermaster's department and from the city veterinarian that there was now and had been a fatal epidemic among the horses in Manila, the quartermaster's department having lost over 200 within the last four months.

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[a] Same as Smith & Kinyoun, 1901.

One of the corrals was visited by us on the 15th instant, where we were shown by the veterinarian in charge 20 horses and mules ill with an undetermined disease. These animals presented the several stages of the malady. Some were quite recently attacked, while others had been ill for over two months.

The symptoms first noticed are impairment of appetite, constipation, fever, and thirst. These are followed within a few days by a rapid and progressive emaciation.

The temperature for the first few days ranges from 104° to 107° F.; the pulse is full and strong. This may be termed the acute state. Then begins an asthenic stage, which may terminate fatally within a variable period, or by a slow convalescence. During this stage, usually within ten days after the onset, there appears a commencing edema above the belly, involving the soft parts; coincident with this, or soon after, the edema extends to the feet and legs. The pulse becomes rapid, weak, and dichrotic; the respiration increased, shallow, and jerky; the gait staggering. Emaciation is rapid and extreme.

The disease has a tendency to relapse; this may occur at any time, even after convalescence appears to have been fully established. The relapses are invariably fatal.

The mortality in this epidemic has been about 75 per cent for American horses and mules and 100 per cent for native ponies.

The gross pathology shows serous effusions into the pleurae, pericardium, and sometimes the peritoneum. There is also a serous exudate into the cellular tissue of the legs and abdomen. The organs are pale, but otherwise normal in appearance.

At the time of our inspection, 5 acute cases were examined, the duration of the attack being from 6 days to 2 weeks. All these animals presented the several clinical appearances as above described.

Blood specimens were taken from the jugular vein of each and examined microscopically shortly afterwards. In 4 of these a parasite was demonstrable. The other was negative, but a specimen taken the following day showed the presence of this same parasite.

On the day following, specimens were obtained from 12 others, all chronic cases, with the result of finding this same parasite in the blood of 4. In 3 they were few, while in the fourth they were present in great numbers; as many as 20 could be seen in one microscope field. The animal from which the specimen was taken had suffered a relapse.

It would appear that the parasite may disappear from the peripheral circulation, or exist there in such few numbers that it is not easily demonstrable after the acute stage has passed. It would require repeated blood examinations to decide this point.

Description of the parasites.

The parasite resembles a whip-like worm, having much the appearance of the *Trichocephalus dispar*. Its length is from 10 to 14 microns, and it is from 1 to 1.2 microns in diameter through its body; the neck is nearly one-half its length, tapering gradually to a point representing the mouth (?). It has a limiting membrane which is well defined; the contour is in most cases symmetrical, but in some the body line is quite irregular. The larger part of the parasite (body) contains granular material and clear spaces, which latter vary in size and number; they are irregularly distributed, and may encroach on the wall so as to cause irregular outline. The granular material does not extend to the neck.

The parasite is actively motile, having both a vermicular (contractile) and spiral movement. It moves forward in a very peculiar manner; the long whip-like process is thrust forward by a spirillar motion, followed by a contraction of the body.

We have not so far been able to determine its intimate structure, further than the limiting membrane, and the protoplasmic substance of the body.

Two sizes of the parasite have been seen in all the specimens examined; the larger appears to be more numerous and contains considerably more granular material than the smaller, and usually two or more vacuoles. Whether these two sizes represent male and female has not been determined. We are inclined to believe from our observations that these do represent the male and female, because we have observed, in more than half the fresh specimens, the joining of a large and small parasite in such a way as to appear to be something more than accidental.

The pathological change caused by this parasite is a rapid destruction of the red blood cells causing an acute anemia. The changes occur in the blood coincident to the invasion of the parasite. In one horse which had been ill 7 days the red blood cells numbered 3,500,900; the white cells, 14,500. In another, ill 6 weeks, the red blood cells were 3,200,000, and the white were 13,900. The blood of a healthy horse, taken as a comparison, gave red blood cells 6,900,000; white, 9,800. There is also a slight diminution in the amount of hemoglobin—about 85 per cent.

After convalescence has been fully established no parasites can be found; the blood gradually assumes its normal constitution.

The parasite is not confined to the blood, as it can be demonstrated in the serous effusions.

It is quite easy to detect. All that is necessary is to make a microscopical examination of fresh-blood films; a one-sixth-inch objective will suffice. Dried films, fixed, and stained with any of the nuclear dyes.

The organism appears to be a strict parasite. It lives but a short time after removal from the body. The longest time which it has been kept alive in blood serum was not more than 10 hours.

The parasite has many of the properties in common with the filaria and resembles more nearly that of the *Filaria perstans*, only it is smaller and its movements dissimilar. Yet, on the other hand, the clinical history of animals infested by it—the changes occurring in the blood, the lesions observed in postmortem—point very strongly toward its classification with the spirochæte.

The mode of transmission has not yet been studied. It does not appear to be highly contagious, as it does not appear to spread from one to another, even under the most favorable circumstances.

It more nearly resembles malaria in this respect. It is more than probable that its extra corporeal state is different, or another supposition equally tenable is that its intermediate host is some insect, such as the fly or mosquito.

ARMY PATHOLOGICAL LABORATORY, *Manila, October 17, 1901.*

Dr. Kinyoun has now returned to the United States, and, according to information we have received from him, the disease found is beyond question identical with surra. It further appears from his letter that Mr. Jobling made the first observation on the disease in Manila. Dr. Kinyoun adds:

> From what I could learn, the disease surra appears to be distributed all over Luzon and has been there for many years. No one seems to know where it came from. I do not think it came from China, as no cases have been reported in Hongkong, where a considerable number of artillery horses are kept.

OBJECT OF THE PRESENT REPORT.

As the disease known as surra is not present in the United States, and as the American text-books on medicine discuss it but briefly, it becomes necessary immediately to place our army officers, our veterinarians, and our live-stock raisers in a position to recognize the malady, should it be introduced into this country. From both a military and an economic standpoint it is also imperative that our officers and sanitary officials now serving in the Philippines should be placed in possession of the present status of knowledge regarding the disease in question. To meet these necessities the present emergency report has been prepared.

IMPORTATION OF PHILIPPINE ANIMALS PROHIBITED.

Immediately upon receiving word that surra existed in Luzon, the Secretary of Agriculture issued the following order prohibiting the importation of any live stock or animals of any kind from the Philippine Islands into the United States:

SPECIAL ORDER PROHIBITING THE LANDING OF ANIMALS FROM THE PHILIPPINE ISLANDS AT ANY OF THE PORTS OF THE UNITED STATES OR OF THE DEPENDENCIES THEREOF.

(B. A. I. Order No. 92.)

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 13, 1901.

Notice is hereby given to the owners, officers, and agents of all steamers and other vessels of all descriptions plying between the Philippine Islands and any of the ports of the Hawaiian Islands, or between the Philippine Islands and any of the ports of the United States or the Territories or dependencies thereof, and to all stockmen and all other persons concerned in any way or manner in the traffic in animals in or with the Philippine Islands, that certain contagious, infectious, and communicable diseases dangerous to the live stock of the United States exist among the animals of the said Philippine Islands, viz, surra, affecting horses, mules, asses, neat cattle, camels, buffaloes, dogs, and apes; foot-and-mouth disease, affecting horses, neat cattle, other ruminants and swine; and rinderpest, affecting neat cattle and other ruminants.

Therefore, under the authority conferred upon me by the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuropneumonia and other contagious diseases among domestic animals," I do hereby prohibit the landing at any of the ports of the Hawaiian Islands or at any of the ports of the United States or of any of the dependencies thereof of any live stock or animals of any kind from the Philippine Islands. This prohibition will take effect immediately and will continue in force until otherwise ordered.

JAMES WILSON, *Secretary.*

TERMINOLOGY.

TECHNICAL NAME.

As there is no Latin term signifying an infection with *Trypanosoma*, and as there is considerable confusion in the vernacular names, we herewith propose to introduce the term *trypanosomiasis*, referring to any infection of any animal with parasites belonging to the flagellate family Trypanosomidæ.

This technical term is therefore analogous to the terms *acariasis*, *ascariasis*, *coccidiosis*, *uncinariasis* (uncinariosis, anchylostomiasis), and *malaria*, in that it is a broad generic term which does not indicate what particular species of the family Trypanosomidæ is present, or what particular host is affected. It does not do away entirely with the names "tsetse-fly disease" and "surra" any more than the term coccidiosis does away with the terms "intestinal, hepatic, or renal coccidiosis," and it has the same general relation to the terms "tsetse-fly disease" and "surra" which the term "malaria" has to "tertian, quartan, estivo-autumnal, human, and avian malaria."

VERNACULAR NAMES.

The technical name *trypanosomiasis* is intended to cover the following vernacular names, compiled from various sources and based either upon prominent symptoms of the disease or upon the hosts of the parasite:

Andar-tap (fever within the body).
Anémie pernicieuse.
Berbad (on wind, wasted away, or spoiled).
Bovine surra (surra of cattle).
Buffalo surra (surra of buffaloes).
Camel surra (surra of camels).
Canine surra (surra of dogs).
Dog surra (surra of dogs).
Doaia (second stage, swelling over the chest).
Equine relapsing fever (at least in part).
Equine surra (surra of horses).
Fish surra (surra of fish).
Galtah (from Gala, meaning throat, as Galtah is a form of surra in camels in which the throat affection is one of the prominent symptoms).
Galtia (melting away).
Glossinose.
Gum-Zaharbad (concealed blood poison).
Horse surra (surra of horses).
Khanhog (first stage, refusing food).
Khusk-Zaharbad (dry blood poison).
La mouche—in Congo.
Marri (plague).
Nikalgaya (passed away, hopeless).
Nagana (tsetse-fly disease).
N'gana (tsetse-fly disease).
Nygana (tsetse-fly disease).
Pernicious anemia of horses (at least in part).
Phenta (fatal).
Phenta-ká-darad.
Phera (bursting of abscess).
Pheta (fatal).
Phetra (abscess).
Phitgaya (burst).
Photra (abscess).
Purana (used up).
Rat surra (surra of rats).
Relapsing fever of equines (Steel, 1886).
Sár (rotten).
Sara (rotten, foul).
Sokra (without flesh and blood, skeleton).
Sukal (drying up).
Surra (third stage, rapid waste).
Tap-dik.
Tapé-dik.
Táp (fever).
Tarai (wet, moist).
Tebersa (three years' duration).
Tibarsa.
Trypanosomose.
Tsetse-fly disease.
Tzetze-fly disease.
Wabai-ki-bokhar (epidemic fever).
Zaharbad (blood poison).
Zherbad (poison wind or miasma).

DIFFERENT KINDS OF TRYPANOSOMIASIS.

At present there are several different kinds of trypanosomiasis usually recognized, but certain authors are of the opinion that at least some of the diseases in question do not in reality represent distinct maladies caused by different species of parasites. We may mention the following in particular:

Surra: A disease of equines, camels, elephants, and certain other animals in India, attributed to *Trypanosoma Evansi.* (See pp. 48, 65.)

Nagana, *nygana*, or *tsetse-fly disease*, of Africa: Affecting cattle, horses, mules, asses, antelopes, camels, and certain other animals; it is attributed to *Trypanosoma Brucii.* (See pp. 66, 140.)

Dourine, or *maladie du coït*, of Algiers, France, and Spain: It attacks the horse and the ass in particular, but may be transmitted to certain other animals; it is attributed to *Trypanosoma equiperdum.*

Mal de caderas, of South America: It affects horses, asses, cattle, hogs, and certain other animals, and is attributed to *Trypanosoma equinum.* (See pp. 67, 154.)

Rat trypanosomiasis: Attributed to *Trypanosoma Lewisi.* By some authors this parasite is alleged to be identical with the horse surra organism, but it is quite certain that rats may harbor a distinct species. (See pp. 63, 155.)

In our present state of knowledge, it is best, for the present at least, to look upon these five maladies as distinct diseases, in the same sense that human and avian malaria are considered as due to distinct, though closely allied, organisms.

SURRA.

DEFINITION OF SURRA.

Surra is a specific and continuous infectious febrile disease occurring in solipeds and camels, and capable of being transmitted by inoculation to other animals. It is due to the presence of a flagellate protozoon (*Trypanosoma Evansi*) in the blood. It is chiefly met with in an epidemic form, during certain months of the year, namely, during or immediately following the wet seasons. It is characterized by an intermittent, remittent, and sometimes a relapsing, type of fever which continues for varying periods, from a few days to months, according to the species and the constitutions of the animals attacked, and presents definite symptoms following one another in regular sequence. The chief symptoms, in addition to the fever, are the occasional appearance of an urticarial eruption, general or localized, closely following the first rise in temperature, but which may make its appearance at any time during the course of the disease; then the presence of petechiæ on the mucous membranes, chiefly those covering the membrana nictitans; lachrymation, and the exudation of a yellow semigelatinous material into the subcutaneous and other connective tissues. There is rapid wasting and great weakness, although in the great majority of cases the appetite remains good throughout, no matter how high the fever is. There is extreme pallor of the visible mucous membranes, and this is followed at a later period by yellowness. From first to last there is progressive anemia; the blood at first presents a normal character, but after a varying period of time undergoes marked changes. The white corpuscles are increased in number, and the red corpuscles usually cease to form normal rouleaux, lose their individuality, and run together, forming irregular masses, which are at first dark, but gradually, as the disease advances, almost entirely lose their coloring matter and become pale.

The presence of the flagellate is not continuous during the whole course of the disease. At first it is usually found in small numbers in the blood, and increases with greater or less rapidity until, having attained a maximum, it disappears either gradually or suddenly, to reappear after an interval. The periods during which it is present in and absent from the blood are marked by extreme irregularity, varying from 1 to 6 days, but the latter number is very unusual.

The disease is invariably fatal, death being generally due to exhaustion, but sometimes to concurrent complications. After death no specific lesion is present, but as a rule there are small subpleural and subendocardial extravasations, together with enlargement of the liver and spleen, and if death takes place during the paroxysm the hematozoon will be found for a certain time in the blood. (Lingard, 1893, pp. 1–2.)

GEOGRAPHICAL RANGE OF SURRA.

According to Lingard (1899, pp. 1–2), the geographical range of this disease is much wider than was once imagined:

"Among the first recognized districts in India were Dera Ismail Khán, on the northwestern frontier, east of the Indus, where the disease has been known for generations, Asni near Rájanpur, Kohat, Upper Burmah, the Island of Bombay, Konkan, Meerut in the Northwest Provinces, in the Berárs, and in Cachar and Assam. It was also reported from the Persian Gulf, Persia, and Tonquin. There were also strong reasons for believing that animals have succumbed to this disease in Abyssinia, the Zambesi, East Africa, Australia, North America, Brazil, and Southern Europe.

"Since the publication of the above report numerous fresh centers have been brought to light. Out of the 31 districts in the Punjab, surra has been found up to the present to be enzootic in 22, the worst being the Karnal district. In the Northwest provinces the disease has been observed in the Saharanpur, Muzzafarnagar, Meerut, Bulandshahar, Gaziabad, and Fyzabad districts; in the northeast portion of the Jalpaiguri district, Bengal. In addition widespread outbreaks have occurred in the Ahmedabad, Baroda, and neighboring localities, which have carried off thousands of equines. Spontaneous cases of surra have also been recognized in Lower Burmah, Rájputana, and Bikanir. One horse also arrived in Bombay from the Persian Gulf suffering from surra.

"In other parts of the world the *Trypanosoma* has been reported from Algeria (equines), France (bovines), Korea (equines and bovines), Egypt and Syria (equines), while in Zululand a *Trypanosoma* has been observed in the blood of equines, bovines, and canines, which is indistinguishable microscopically from the flagellated protozoon found in the circulation of animals in India."

We are not familiar with the data which led Lingard to indicate that animals have succumbed to surra in North America, but it does not seem impossible that a confusion with Texas fever has arisen. The references to Africa apparently refer to nagana, which Lingard considered identical with surra. Further, the possibility does not appear to be absolutely excluded that some other cases of alleged surra may have been erroneous diagnoses of other maladies, especially in cases where the deaths are taken from reports not based upon blood examinations.

HISTORY OF SURRA.

Surra has been known in India for several generations. It was first brought to the attention of the rest of the world in a report to the government of India, written by Griffith Evans, M. D., published November 13, 1880. Since that time numerous papers on the subject have been printed, especially by physicians and veterinarians in the service of the English Government. Alfred Lingard, imperial bacteriologist in India, has been especially active in his researches, and has published a number of exceedingly valuable reports on the subject, containing numerous clinical histories, tables, analyses, etc. The other workers who have made valuable contributions to the surra literature may be seen from the references and the bibliography of the present report.

ORIGIN OF SURRA IN THE PHILIPPINES.

Our information from Manila is not yet sufficiently detailed to enable us to judge with certainty whether surra has existed many years there or whether it was recently introduced. If it has been recently introduced, it seems very possible, from our present incomplete knowledge of the exact data, that it was carried to China by the English troops from India, and that our troops carried it from China to the Philippines. This explanation is, however, purely in the line of speculative possibility, and is not in accord with the statements made by Dr. Slee (see pp. 42–43) and Dr. Kinyoun (p. 45), though from present accessible data it does not seem to be entirely established that the disease mentioned as existing in previous years was of the same nature. The point in question can be established in the Philippines better than by us here in Washington.

CLIMATIC INFLUENCES GOVERNING SURRA.

All authors agree that surra is a disease which coincides with moist conditions, occurring during or immediately following the heavy rainfalls, although it is admitted that sporadic cases may occur at other seasons of the year—for instance, those which are hottest. In the same way it is described as being influenced by floods and inundations, and as being common in the vicinity of water, as canals, rivers, etc.

Lingard (1893, p. 49) refers to 85 cases of naturally acquired surra which he compiled from the records of the Bombay Tramway stables, and shows that 84 of these, or 98.8 per cent, occurred during the months of September to December.

The following passage from Lingard (1899, pp. 73–74) bears upon this point:

> RAINFALL AND SURRA.
>
> "The question as to what conditions influence the early or late advent of surra in horses is one of especial interest and importance, both from a practical and scientific standpoint. It is only in government and private establishments, however, where careful records are collected concerning the disease, that details can be obtained from which deductions of any value can be drawn. In 1890, efforts were made in this laboratory to compile statistics with a view to determine what effect is produced on the appearance of the disease by the varying amount of rainfall in different years. At present we have obtained statistics for the past ten years with regard to the date on which the disease first made its appearance at the stables of the Bombay Tramway Company, together with the records of rainfall during the same period.

Table showing the monthly rainfall in Bombay for the years 1888–1897, with the dates of surra outbreaks, and the number of horses attacked in each surra season at the Bombay Tramway Company's stables.

MONTHLY RAINFALL.

Months.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
January	1.85	....	....	....	....	....	0.22	....	....	0.01
February	.02	....	....	....	....	0.14	....	0.07	....	....
March	.10	....	....	0.20	....	....	.06	....	....	....
April	....	....	0.01	....	....	.02	.01	....	....	....
May	....	0.67	.06	....	0.11	6.30	....	.08	0.26	....
June	15.76	19.89	24.55	13.99	13.30	21.47	16.87	17.84	28.02	14.40
July	22.47	30.15	21.34	32.48	23.86	16.14	26.16	18.04	36.44	30.19
August	11.43	10.32	10.61	6.94	36.56	13.57	8.40	15.97	20.77	13.82
September	4.92	2.71	6.45	22.53	18.73	7.52	12.04	11.91	1.62	20.60
October	.11	3.80	.58	1.04	1.89	.45	3.08	3.62	.01	2.51
November	1.16	....	1.25	....	.67	1.63	....	.06	.53	....
December	....	....	.13	....	....	.22	.01	....	....	....
Total rainfall for year	57.82	67.84	64.98	77.18	95.12	67.46	66.85	67.59	87.65	81.53
Total rainfall from May 1 to date of outbreak of surra	54.69	61.97	63.56	66.50	81.87	39.41	44.09	52.02	85.49	81.52

Table showing the monthly rainfall in Bombay for the years 1888–1897, etc.—Continued.

OUTBREAKS OF SURRA.

Year.	Date of outbreak.	Year.	Date of outbreak.
1888	Oct. 18	1894	Aug. 11
1889	Sept. 14	1895	Sept. 2
1890	Oct. 6	1896	May 9 Aug. 30
1891	Sept. 13		
1892	Sept. 12	1897	Nov. 26
1893	July 20		

NUMBER OF HORSES ATTACKED EACH YEAR.

Year.	Number attacked.	Year.	Number attacked.
1888	14	1893	11
1889	47	1894	10
1890	2	1895	17
1891	1	1896	19
1892	15	1897	3

July 20, 1893, 3 horses attacked—1 Australian, 1 Arabian, 1 Persian.
May 9, 1896, 1 case of surra, most unusual.
August 30, 1896, regular outbreak commenced.
November 26, 1897, 3 Australians at Parel stables. Flies very troublesome.
Average annual rainfall for ten years, 73.40 inches.
Average for ten years, 67.35 inches.
Average death rate from surra for ten years, 13.9.

"As will be observed on reference to the above table, the most common months for surra to appear (six times out of ten) were September and October; twice it appeared in August and once in July and November, respectively. When a rainfall of 6.3 inches fell in Bombay in May, 1893, 3 horses were attacked on the same day, namely, July 20. It was then considered that the disease might be accounted for by the hematozoon or its resting form having escaped the great heat during the month of May, and so have retained its vitality, so that its power of reproducing the disease would be increased by the earlier rainfall, and the outbreaks of surra thus occur sooner. But in 1896 a sporadic case of surra occurred among the same stud, consisting of some 700 horses, on the 9th day of May, a most unexpected occurrence, as up to that time only 1 animal (Australian, No. 65, owned by a private individual) had been observed with the disease, and that was contracted in the districts. From the 1st of the previous November until May 9, 1896, only 0.06 of an inch of rain fell, and that was in the first-mentioned month. Consequently, here we have undoubted proof, confirmed by microscopic examinations of the blood of the animal, that surra may appear in Bombay in the hottest part of the year, when no rain has fallen for 6 months. In 10 years 1 animal out of 139 attacked with surra developed the disease in the month of May, but the annual outbreak at these stables which carried away 17 horses did not occur until September, October, and November of the same year, toward the end of the monsoon season. On the other hand, it is a well-established fact that in the great majority of years during which an excess of rain falls, the most severe outbreaks of surra occur. In support of this statement the following outbreaks may be brought forward. During 1894 heavy rain fell on several successive days in September in the Ahmedabad, Baroda, and neighboring districts. Thousands of equines succumbed to surra during the October and November following, over an area of 400 square miles; and by order of the Government the horse fair at Ahmedabad was abandoned for a period of 2 years.

"Again, on the Saharanpur-Mussoorie dâk line, 77 animals died of surra, at stations in the Mohand Pass, during the rains of 1894, when the rainfall was in considerable excess of the normal.

"In 1895, during the rains, which were heavy, surra caused its ravages in over 200 villages in the Karnal district, Punjab. The losses among equines in 16 villages in the above tahsil, where statistics were forthcoming, were 253 out of 556 kept, or 45.5 per cent. During the same period 53 villages in the Saharanpur district, northwest provinces, lost 909 out of a total of 1,590, or 57.1 per cent.

"Let us now consider the outbreaks which occur annually at the foot of the outer Himalayas at Kathgodám in the Kumaon Bhabar. At my request, meteorological observations were commenced at this station in 1896, and the following table shows the information we require, but for the past 2 years only:

Table showing rainfall June 1 to October 31, in inches.

Stations.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
Naini Tal, elevation 6,350 feet......	123.02	81.85	63.73	126.91	105.19	85.10	63.85	114.93
Kathgodám, elevation 1,630 feet....	....	....	....	....	....	....	50.71	108.52
Haldwani, elevation 1,200 feet......	100.06	65.91	56.38	83.73	92.96	69.16	63.82	91.86
Average number of horses....	90	93	93	180	128	131	101	80
Horses died (of surra) between the Brewery and Kathgodám.........	40	10	5	2	63	8	92	2

"In 1896, 19.4 inches of rain fell during the month of June, and at the time that the monsoon ceased somewhat abruptly in August, 50.31 inches had fallen. Surra broke out among the dâk animals in July, and 32 succumbed up to the end of August. When I visited the station on the 5th of September, the blood of 24 ponies was found to contain the organism on microscopical examination, and in 9 animals it was found within the next few days, making 33 in all. Different varieties of flies make their appearance during the fine intervals of the monsoon, and in the year in question, when the rains terminated in August, flies invaded the tonga road in very large numbers, but no examples of the *Glossina morsitans* were discovered. As the diseased animals were not destroyed, or even isolated, we have not far to seek for the cause of the terrible mortality among the tonga ponies. In the following year (1897), the rains only commenced on the 12th of July, but continued until the month of October, a total of 108.52 inches falling. During the last-mentioned season, however, immediately a tonga animal was reported with fever, it was at once segregated, some miles away from the rest of the ponies, with the result that only 2 animals have succumbed to surra during the season. It would also appear that the lateness of the setting in of the monsoon, together with the heavy downpour when it set in, and want of sunlight and warmth, also contributed and brought about conditions unfavorable for the development of the *Trypanosoma* and flies in general.

"With regard to surra in other than tonga ponies, it is no good the railway company going to great trouble and expense in order to provide boiled water, grass from an elevation of 6,000 feet, clean corn, prohibiting the use of green vegetation during the rainy season, and segregating all their sick animals, if small private owners of ekka and riding ponies, etc., are allowed to keep their diseased animals in sheds or wandering about unattended within a few yards of the company's stables or are allowed to ply for hire along the same narrow road. It stands to reason that the myriads of flies which abound and infest all animals at these seasons have only to carry the contagion a distance of a few yards from the diseased to the healthy animals. In order to save expense and trouble, the native owners, on recognizing that their tats are suffering from a fatal disease, turn them loose to shift for themselves; consequently they become a source of danger to every healthy animal in the neighborhood during life, and a disagreeable stimulus to the olfactory organs of passers-by for a varying period after death."

The explanation that the hematozoon would have its power of reproducing increased by rainfall should, perhaps, be accepted with some reserve. At least, another explanation occurs to us which seems more in accordance with analogy. In dry weather biting flies are not so active as in moist weather, and flies which are in a pupal stage are not so likely to issue. When a rain comes, however, flies issue from the pupæ in the dry ground and proceed to breed rapidly. Thus, during and following rainfall there would be more biting insects flying, hence there would be a greater chance for spreading the malady. (See pp. 51, 77.)

RESIDENCE IN INFECTED COUNTRY.

Of 80 cases compiled by Lingard (1893, p. 49), 16.25 per cent occurred in animals which had been in the country for varying periods of less than 1 year; 76.25 per cent succumbed within the first 7 of the 14 years under observation.

INFLUENCE OF SEX, AGE, AND BREED.

According to Lingard (1893, pp. 47–48), sex plays no rôle in reference to surra; both mares and horses are affected. Of 85 animals referred to, 45.8 per cent were between 5 and 9 years old. Of these same animals, 80 per cent were Australians, and the statistics of the Bombay Tramway Company show that Australian horses are much more subject to the disease than are the Asiatics. White and gray mules are said to be more susceptible than darker animals.

SPECIES OF ANIMALS SUBJECT TO SURRA.

Surra is found especially in horses, asses, and mules, but is not confined to these species. Outbreaks of the disease are reported also for camels, elephants, cats, and dogs, and the disease has been transmitted by inoculation to cattle, buffaloes, sheep, goats, rabbits, guinea pigs, rats (*Mus decumanus*, *Nesokia providens*), and monkeys. The limits of its infectivity are not yet established, and on this account all mammals must, for the present, be considered as *possible* carriers of the malady until negative experiments prove them to be refractory. No birds, reptiles, amphibia, or fish are known to harbor the parasite (*Trypanosoma Evansi*).

PARTIAL LIST OF OUTBREAKS.

From the high mortality of surra, it may be seen that this disease is exceedingly important from both an economic and a military standpoint. In order to give an idea of the losses which have occurred, the following partial list of the outbreaks, compiled by Dr. Albert Hassall, is here appended:

1878.

PUNJAB.

Griffith Evans, 1881, p. 2: Fourth Punjab Cavalry lost 40 horses.

1879.

Griffith Evans, 1881, p. 2: Fourth Punjab Cavalry lost 118 horses.

1880 (to September).

Griffith Evans, 1881, p. 2: Fourth Punjab Cavalry lost 114 horses.

Before 1881.

ARSENE.

Griffith Evans, 1881, p. 2: Third Punjab Cavalry lost 350 horses from surra a few years ago.

1885.

HUNG-HOA.

Blanchard, 1888: Many mules in Twelfth Regiment Artillery died of an affection designated at Tonkin under the name anémie palustre, fièvre ou cachexie palustre.

Before 1887.

Burke, 1891, p. 270: Bengal Cavalry, 180 horses died.

Before 1890.

KATGODAM, NORTHWEST PROVINCES.

Lingard, 1894a, p. 1: Many tonga ponies (principally cabulis) succumbed to surra.

1890.

FAZILKA TEHSIL, FEROZEPUR DISTRICT.

Lingard, 1898a, p. 8: Lost a few animals.

KATGODAM, NORTHWEST PROVINCES.

Lingard, 1894a, p. 1: 40 ponies also died.

MANIPUR.

Lingard, 1895, p. 1: 80 out of 230 equines died. Elephants unaffected.

1891–1893.

KATGODAM, NORTHWEST PROVINCES.

Lingard, 1894a, p. 1: 15 ponies died between 1891–1893.

1891–1894.

SHUTRA-KHÁNA STUD AND GANGU RISALD.

Lingard, 1895, p. 2: 740 camels have died of surra.

1892.

WAZIRABAD TEHSIL, GUJRANWALA DISTRICT.

Lingard, 1898a, p. 8: 5 horses and 10 asses.

1892-1896.

SONEPUT TEHSIL, DELHI DISTRICT.

Lingard, 1898a, p. 10: 48 horses, 38 mules, and 8 asses died.

1893.

BOMBAY.

Lingard, 1894a, p. 1: A horse arrived in the port of Bombay from the Persian Gulf suffering from surra.

BURMAH.

Lingard, 1894a, p. 1: The Kachnis lost 14 elephants from the disease, out of a total of 32.

CHINDWIN.

Lingard, 1895, p. 2: Bombay-Burmah Company lost 24 elephants, valued at 45,000 rs.

SÁHÁRÁNPORE AND MUSSOORIE.

Lingard, 1894a, p. 1: Outbreak occurred in the stables of the dâk ponies.

SECUNDERABAD.

Lingard, 1895, p. 1: First Madras Lancers lost 49 country-bred horses.

WAZIRABAD TEHSIL, GUJRANWALA DISTRICT.

Lingard, 1898a, p. 8: 3 horses and 5 asses.

1893-1894.

GÁIKWÁRI DISTRICT.

Lingard, 1895, p. 1: A large number of horses and donkeys died all over the district.

MUSSOURIE ROAD, BETWEEN SAHARANPUR AND RÁJPUR.

Lingard, 1895, p. 1: Owners of dâk ponies lost 146 animals from surra.

1893-1895.

WAZIRABAD TEHSIL, GUJRANWALA DISTRICT.

Lingard, 1898a, p. 8: Several horses and mules died, being equivalent to 45 per cent of the animals possessed.

1893-1896.

FEROZEPUR TEHSIL, FEROZEPUR DISTRICT.

Lingard, 1898a, p. 8: 17 villages affected.

1894.

AJNALA TEHSIL, AMRITSAR DISTRICT.

Lingard, 1898a, p. 9: Lost 62 horses, 34 asses, 1 mule—92 per cent of horses, 40 per cent of asses, and 100 per cent of mules.

AURANGPUR, NANGALA, AND DADRI.

Lingard, 1895, p. 2: 15 ponies died.

BAREILLY.

Lingard, 1895, p. 1: One outbreak occurred, in which all animals affected were either killed or died of the disease.

BAREILLY AND RÁNIKHET.

Lingard, 1895, p. 1: Government commissariat department lost 100 mules in October.

Lingard, 1895, p. 1: Bombay mounted police lost 11 horses.

GUJRANWALA TEHSIL, GUJRANWALA DISTRICT.

Lingard, 1898a, p. 8: 23 horses and 21 asses died.

JAGADHERI TEHSIL, UMBALLA DISTRICT.

Lingard, 1898a, p. 9: 17 asses died — 76 per cent.

Katgodam-Naini Tal Tonga service.
Lingard, 1895, p. 1: Lost 67 animals out of 128.

Páli.
Lingard, 1895, p. 1: 50 brood mares and young stock belonging to Mahárájah Sir Pertáb Singh died.

1894-1895.

Delhi.
Lingard, 1895, p. 2: An outbreak occurred among cavalry horses.

Gujerát, Ahmedabad, Baroda, etc.
Lingard, 1895, p. 1: A very severe and widespread outbreak involving an area of 400 square miles.

Hoshiarpur district.
Lingard, 1898a, p. 9: 61 horses and 32 asses died—82 per cent of horses and 64 per cent of asses.

Lahore Tehsil, Lahore district.
Lingard, 1898a, p. 8: 24 horses and 22 asses died.

Panipat Tehsil, Karnal district.
Lingard, 1898a, p. 9: 28 horses died.

1895.

Chunian Tehsil, Lahore district.
Lingard, 1898a, p. 8: 12 horses died.

Jagadheri Tehsil, Umballa district.
Lingard, 1898a, p. 9: 80 per cent of horses, 100 per cent of asses and mules died.

Jagraon Tehsil, Ludhiana district.
Lingard, 1898a, p. 9: In the village of Man 42 camels died.

Karnal Tehsil, Karnal district.
Lingard, 1898a, p. 9: 24 horses, 20 asses, and 15 mules.

Khangah Tehsil, Gujranwala district.
Lingard, 1898a, p. 8: 2 asses only.

Lodhrian Tehsil, Mooltan district.
Lingard, 1898a, p. 8: 24 horses died—64 per cent.

Muktsar Tehsil, Ferozepur district.
Lingard, 1898a, p. 8: 8 horses died.

Nawashahar Tehsil (July to August).
Lingard, 1899, p. 9: In two villages, 8 horses and 20 asses died out of 21 and 27 animals, respectively.

Peshawar Tehsil, Peshawa district.
Lingard, 1898a, p. 8: 3 horses died—16 per cent of the animals.

Pipli Tehsil, Umballa district.
Lingard, 1898a, p. 9: Surra occurred in Radour, but losses were not heavy.

Umballa Tehsil, Umballa district.
Lingard, 1898a, p. 9: 25 asses died—20 per cent.

1895-1896.

Jagraon Tehsil, Ludhiana district.
Lingard, 1898a, p. 9: 38 horses and 14 asses died.

Kaithal Tehsil, Karnal district.
Lingard, 1898a, p. 9: 9 horses and 71 asses died.

1896.

Burmah.
Lingard, 1898a, pp. 12-16: Vet. Capt. George H. Evans reports an outbreak among military and police ponies at Mandalay, and records 2 deaths from surra and 14 killed on account of the disease; also 22 mules destroyed.

KATGODAM, NAINI TAL DISTRICT.
Lingard, 1898a, p. 10: 32 horses died between July 1 and September 4.
KHANGAH TEHSIL, GUJRANWALA DISTRICT.
Lingard, 1898a, p. 8: 9 villages suffered loss from surra; 1 animal died in March, the others (?) during August, September, and October.
PIND DADAN KHAN TEHSIL, JHELUM DISTRICT.
Lingard, 1898a, p. 8: 5 animals died.
PIPLI TEHSIL, UMBALLA DISTRICT.
Lingard, 1898a, p. 9: "Chibha" suffered somewhat from the disease.

1896–1897.

BOMBAY. BOMBAY PRESIDENCY.
Lingard, 1898a, p. 11: 20 horses died.
GURDASPUR DISTRICT.
Lingard, 1898a, p. 9: Losses very small.
JABBALPUR, CENTRAL PROVINCES.
Lingard, 1898a, p. 11: 23 horses in all died of surra up to February 17, 1897.

LETHALITY OF SURRA.

Nearly all authors agree that surra in equines and camels is "invariably fatal." Thus, Griffith Evans (1881, p. 3) says that weak animals succumb soonest; (p. 7) records of the Fourth Punjab Cavalry show that no cases on the sick list ever recover; a few cases are said to have made slow progress in the disease, alternately better and worse for over a year; but they all eventually succumbed. Burke (1888a, p. 9) refers to surra as "extremely fatal," and (p. 85) quotes Steel as describing it as "invariably fatal;" later Burke (1891, p. 268) says that there is probably no disease in which the fatality is so high as in "pernicious anemia" (which he identifies with surra). Ranking (1891a, p. 399) also designates surra as "invariably fatal," and Lingard (1893, p. 79) says that surra in equines is "always fatal in the horse, mule, and camel, but in the bovine species after a period, during which the animal suffers from fever, and the infusorian is present in varying numbers in the blood, the animal generally returns to a normal state of health." (See also, 1899, pp. 80–88.) Pease (1897, p. 551) claims to have seen thousands of cases, but he never saw one recover spontaneously; "surra is invariably fatal;" (p. 556) in camels it runs a slow course, nevertheless, in the end the camel dies of surra, sometimes after so long a period as two or even three years; he (pp. 557–558) has seen all the dogs of a village swept off by this malady after eating surra carcasses. Cats also take the disease in the same way. Hayes (1898, p. 481) agrees that surra is "invariably fatal" unless treated with arsenic. Burke (1897, p. 192), on the other hand, states that if surra is treated with quinine, arsenic, iron, and other tonics, by changing the water and making some variation in the location of the animals, great benefit and even absolute removal of the disease may be secured.

(See also "Treatment," p. 121.)

IMMUNITY TO SURRA.

In 1893, Lingard (p. 7) stated that death follows the first attack in all the animals discussed, with the exception of the bovine species, and that his experiments tended to prove that one attack may grant immunity to this animal, at all events for a considerable period. It was later shown by Lingard (1895, p. 7) and others that one attack does not render an animal immune. He gives the following case:

> "An Australian gelding, the subject of surra in December, 1893, was cured of this disease by the administration of arsenic and iodide of arsenic and mercury.
>
> "Between March and October, 1894, the animal gained 235.75 pounds in weight, and was in a perfect state of health and condition. Fifteen months after the date of the previous attack, and 12 months after the cure was effected, the animal was inoculated with a minute drop of surra blood—a mere trace of soiled blood being smeared over a scratch on the muzzle—in order to ascertain whether any immunity had been conferred by the previous attack. The latent period of the second attack occupied 7 days. The progress of the disease was marked, as usual, by paroxysms of fever and intermissions, the former occupying a much more prolonged period (22 days), and the latter being shorter than usual (only 2 days).
>
> "Death took place on the fifty-third day of the disease, clearly proving that one attack of surra is unable to protect against a second attack."

Quite recently, Lingard (1901, p. 3) states that he has worked out a serum which has been found to possess immunizing power, but difficulty has been experienced in preserving its destructive power for any length of time. He does not state how this serum is obtained, but says that his experiments will be continued.

CAUSE OF SURRA.

Zoological position of the parasite Trypanosoma Evansi.

The parasite in question belongs to the Protozoa, class Mastigophora, subclass Flagellata, order Monadida, family Trypanosomidæ, genus *Trypanosoma*, species *Trypanosoma Evansi*. The characters of these groups may be seen from the following diagnoses and keys:

CLASS MASTIGOPHORA BÜTSCHLI.

CLASS DIAGNOSIS.—Protozoa: Microscopic organisms, whose bodies usually have a definite form but are not always provided with a cell membrane; cilia are absent, but the adult stage possesses one or several flagella; mouth present or absent; usually only one nucleus present, but never a paranucleus, and usually one or several pulsating vacuoles; reproduction by division, with or without conjugation and encystation.

The systematic position and the limits of this class are debatable questions. They may be placed under the rhizopods or near the ciliates. Some of the forms which certain authors admit to the class as animals other authors place among the plants. Some forms described or identified as flagellates may perhaps be only developmental stages in the life cycle of other animals. Flagellate stages occur, for instance, in the life cycle of some of the Mycetozoa and Sporozoa. Some of the flagellates described as parasitic are considered by certain authors as pathogenic, by other authors as harmless messmates. Quite a number of generic names have been used to designate the forms reported for man, but many of them will undoubtedly fall as synonyms. Numerous species are likely to be swallowed in drinking water. Under existing circumstances, the physician will do well to exercise considerable reserve in dealing with flagellated organisms; otherwise he may be led to erroneous conclusions.

In general, but especially in reference to the lower forms, it may be said that the protoplasm is quite homogeneous; a nearly fluid endoplasm may be recognized surrounded by a peripheral ectoplasm, the latter in turn may be bounded by a more dense layer, like a delicate cell membrane. These three divisions are, however, not always very distinct, but grade almost imperceptibly into one another. The pharynx is a very superficial infundibulum; a permanent anus appears to be absent, but the excreta appear to be expelled from a less resistant point at the posterior extremity, without, however, leaving any trace of their passage. The flagellum represents an organ of locomotion, and there may be one or more present. The pulsating vacuole is near the surface, but does not appear to possess either a distinct membrane or a permanent pore. The nucleus is rounded and appears to be provided with a nuclear membrane and a nucleolus. If conditions become unfavorable, as when the medium becomes too condensed by evaporation or too toxic by extreme putrefaction, the flagellate may discard its flagellum, become round, and form a surrounding cyst membrane; upon return of favorable conditions, it may escape from the cyst and, forming a new flagellum, recommence its active life; or it may divide during the encystment. The division of the free form in multiplying is usually longitudinal. In some cases, the organism encysts before dividing, then by longitudinal division two organisms are formed; the latter may then escape, form their flagella, and become active; or each daughter organism may reencyst and divide further; or the mother flagellate, when encysted, may divide into a large number of so-called "spores," each of which, upon escaping, forms its flagellum. There may also be a complete conjugation of two individuals, followed by encystment and division into numerous young.

It should be further remarked that, while some species are exceedingly simple in structure, as described above, other species are much more complicated and give rise to more or less complex colonies. For these forms, which have not yet been shown to have any particular medical bearing, the reader is referred to the writings of Kent, Bütschli, Delage, Calkins, and others.

Authors are not united upon the subdivisions of this class. Some writers admit three subclasses, others admit four, still others admit five. The following key will aid in determining at least three subclasses which are recognized by most authors:

KEY TO THE SUBCLASSES OF THE MASTIGOPHORA.

1. Protoplasm of body not reticulate 2
   Protoplasm reticulate or branched; one flagellum (feeler) present; a firm membrane present; marine organisms of considerable size..........Cystoflagellata.
2. Shell usually has two grooves or furrows, one running around the body, the other longitudinally; marine and fresh-water forms.................Dinoflagellata.
   The grooves or furrows are absent ....Flagellata.

SUBCLASS FLAGELLATA.

SUBCLASS DIAGNOSIS.—Mastigophora: Small organisms, usually with a sharply defined, mononucleate body, with a definite anterior end bearing one or more flagella; actively motile during life, but possessing power of encystment; reproduction by longitudinal division, in free or encysted stage.

The Flagellata represent the only subclass of Mastigophora which at present comes into consideration as parasites. Owing to the minuteness of the objects, hence the difficulty of recognizing characters for classification, there is a wide difference of opinion among authors relative to the subdivision of the subclass into orders, families, genera, and species.

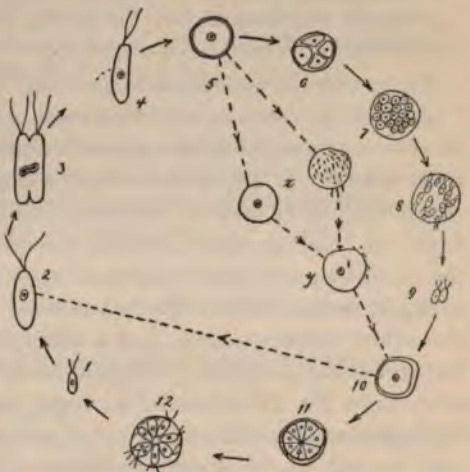

FIG. 1.—Diagram of variations in life cycle of flagellates: 1, a young flagellate; 2, adult flagellate; 3, longitudinal division of adult free form; 4, daughter flagellate; 5, encystation; 6-8, division into isogametes; x, division into macrogametes and microgametes, characteristic for some forms; 9, conjugation of the isogametes; y, conjugation of the micro- and macro-gametes; 10, resting stage—zygote; 11-12, division into young. (After Doflein, 1901, p. 53, fig. 29.)

ORDER MONADIDA.

ORDINAL DIAGNOSIS.—Flagellata: Independently living organisms, but in some cases forming colonies; arrangement of the flagella varies: 1 flagellum, usually anterior, or 2 equal flagella, or 2 unequal flagella, or 1 large and 2 small flagella; undulating membrane may be present.

FAMILY TRYPANOSOMIDÆ DOFLEIN, 1901.

FAMILY DIAGNOSIS.—Flagellata: Parasitic forms with one chief flagellum directed anteriorly; in some forms a secondary flagellum directed posteriorly; body usually with two angles, and wound more or less in the form of a spiral; one angle of body provided with an undulating membrane. One nucleus and one centrosome present.

TYPE GENUS.—*Trypanosoma.*

The family at present contains two genera, which are distinguished as follows:

One flagellum present, extending from the centrosome along the undulating membrane and becoming free at the anterior extremity..............*Trypanosoma*, p. 62.
Two flagella, one extending anteriorly, the other posteriorly..*Trypanoplasma*, p. 72.

Genus Trypanosoma[a] *Gruby, 1843.*

GENERIC DIAGNOSIS.—Trypanosomidæ: Body fusiform, presenting a lateral longitudinal undulating membrane, the thickened border of which terminates posteriorly, in the posterior half of the body, in a "centrosome," and is prolonged anteriorly in a free major flagellum; nucleus generally anterior; there is a tendency to agglomeration by the posterior extremity; division longitudinal and unequal. Parasitic in blood of vertebrates.

TYPE SPECIES.—*Trypanosoma rotatorium.*

Doflein divides this genus into three subgenera, as follows:

1.	Major flagellum present	2.
	Major flagellum absent, or very short and thick	*Trypanosoma.*
2.	Undulating membrane continued posteriorly in a flagellum, so that 2 flagella are present	*Trypanomonas.*
	Posterior flagellum absent, undulating membrane ending on or before end of body	*Herpetosoma.*

From our present knowledge this division is not free from objection. Doflein is in error in selecting two of his names: *Trypanosoma* would, of course, remain the subgeneric name for the group containing *Tr. rotatorium.* If *Tr. Evansi* were recognized as belonging to a distinct subgenus, *Herpetosoma* Doflein, 1893, would have to be rejected in favor of *Hæmatomonas* Mitrophanow, 1883, as Doflein includes both *Tr. cobitis* and *Tr. carassii* in *Herpetosoma.* Laveran & Mesnil, however, have shown that *Tr. rotatorium* presents the same characters as the other trypanosomes, and a division of these forms into subgenera hardly seems justified. *Trypanomonas* Danilewsky, 1885, can not possibly take *Tr. Danilevskyi* as type, unless all of Danilewsky's names are rejected, and the subgenus is attributed to Labbé, 1891. *Trypanomonas* was based upon structures interpreted as young stages named *Trypanomonas ranarum*=*Trypanosoma rotatorium*, hence takes this species as its type, and thus becomes a synonym of *Trypanosoma* (*Trypanosoma*). Laveran & Mesnil, 1901g, have now separated "*Trypanosoma* (*Trypanomonas*)" of Doflein as a distinct genus, *Trypanoplasma*, with *Trypanoplasma Borreli* as type species.

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[a] SYNONYMS.—Under *Amœba* Mayer, 1843 [not *Amœba* Ehrenberg]; *Trypanosoma* Gruby, 1843 (type, *Tr. sanguinis*=*rotatorium*); *Monas* Lieberkühn; ? *Globularia* Wedl, 1850 [not Swains., 1840, mollusk]; *Undulina* Ray Lankester, 1871 (type, *U. ranarum* =*Trypanosoma rotatorium*); *Herpetomonas* Kent, 1880 [only in part, as the type is *H. muscæ-domesticæ*]; *Paramecioides* Grassi, 1881 (type, *P. costatus*=*Trypanosoma rotatorium*); "*Tripanosoma* of Gruby" of Lanessan, 1882, and Balbiani, 1888; *Hæmatomonas* Mitrophanow, 1883 (type, *H. cobitis*); *Trypanomonas* Danilewsky, 1885 (type, *Trypanomonas ranarum*=*Trypanosoma rotatorium*); "*Spirochæte* of Steel, 1885" noted also as *Spirochetæ* and *Spirochæta*]; "*Hemotomonas*" of Blanchard, 1888; *Trichomonas sanguinis*" of Crookshank, 1886, as "subgenus;" "*Triponomonas* Crookank" of Balbiani, 1888, p. 399 [probably a typographic error *o* for *a*, and confusion tween *Trypanomonas* Danilewsky and *Trichomonas*]; "*Trypanosomes* Gruby" of weran, 1895; *Trypanosomum* Chauvrat, 1896; "*Trypanosome* Gruby" of Buffard & r, 1900; "*Paramæcioides* Grassi, 1882" of Laveran & Mesnil, 1901; "*Trylein*, 1901," typographical error for *Trypanosoma.*

DESCRIPTION OF PLATE I.

Figs. 21–29.—Reproduction of *Trypanosoma Lewisi* in the rat. X about 2,000 diameters. (After Laveran & Mesnil, 1901e, pl. 11, figs. 1–9.)

Fig. 21.—Slender adult form.

Fig. 22.—Swollen form preparing to divide.

Fig. 23.—Division of the centrosome and of the base of the flagellum.

Fig. 24.—The division into two organisms is almost accomplished; one of the two individuals bears the old flagellum, the other a newly formed short flagellum.

Fig. 25.—Stage of multiplication with 4 elements, 3 have new flagella, the fourth bears the old flagellum.

Fig. 26.—Stage of multiplication of the nucleus and of the centrosome, not yet accompanied by the division of the protoplasm; one of the flagella is larger than the others.

Fig. 27.—Complete rose cluster of 10 small elements on the point of separating.

Fig. 28.—Free young form.

Fig. 29.—Young form in the act of dividing.

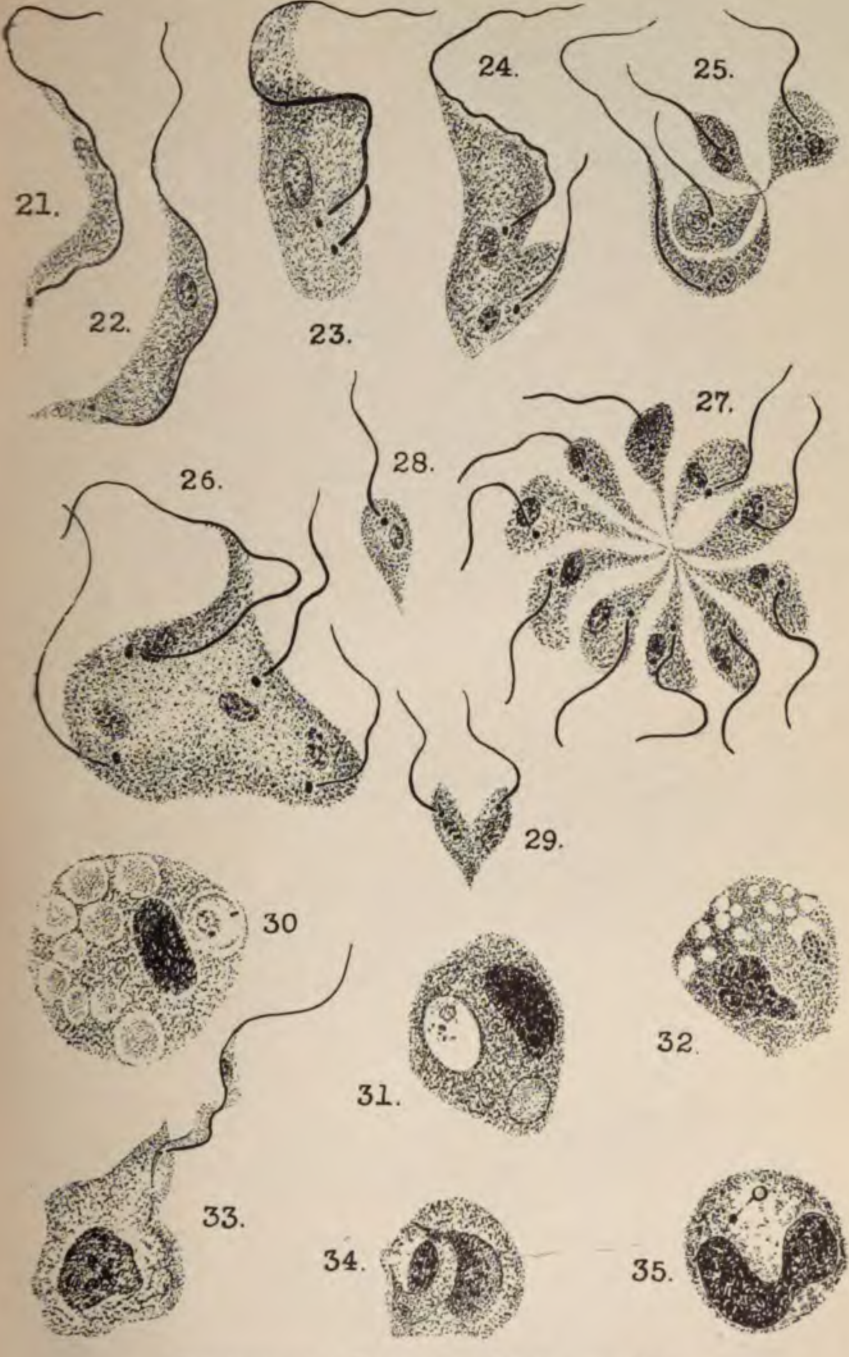
Fig. 30–35.—Ingestion of the trypanosoma by phagocytes. X about 1,100 diameters. (After Laveran & Mesnil, 1901e, pl. 11, figs. 10–15.)

Figs. 30–32.—Three phases of the digestion of trypanosoma by mononuclear leucocytes of the peritoneal exudate of a guinea pig; two of these leucocytes have also swallowed blood corpuscles.

Figs. 33–34.—Two phases of indigestion of trypanosoma by leucocytes of the peritoneal exudate of a rat having active immunity.

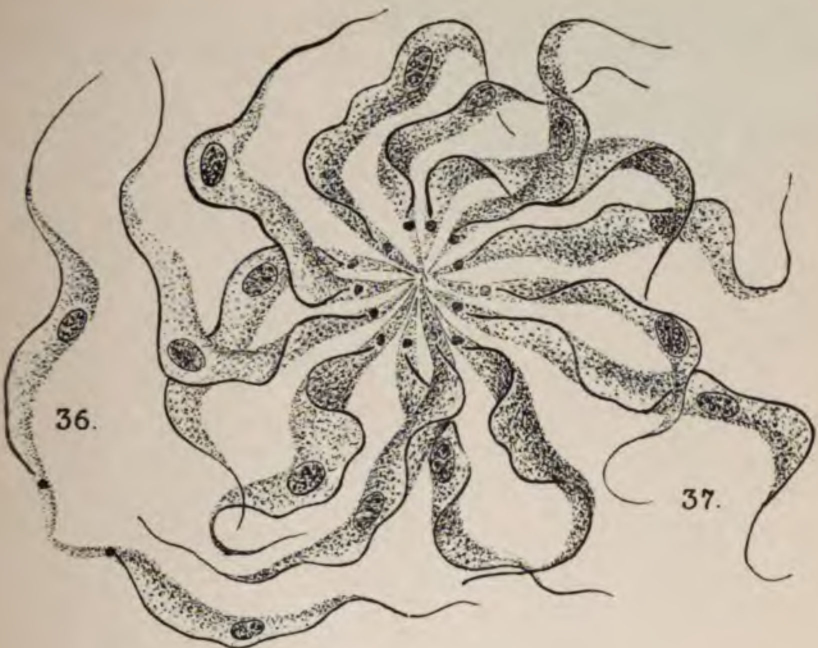
Fig. 35.—Chromatic mass in a leucocyte of a rat; passive immunity.

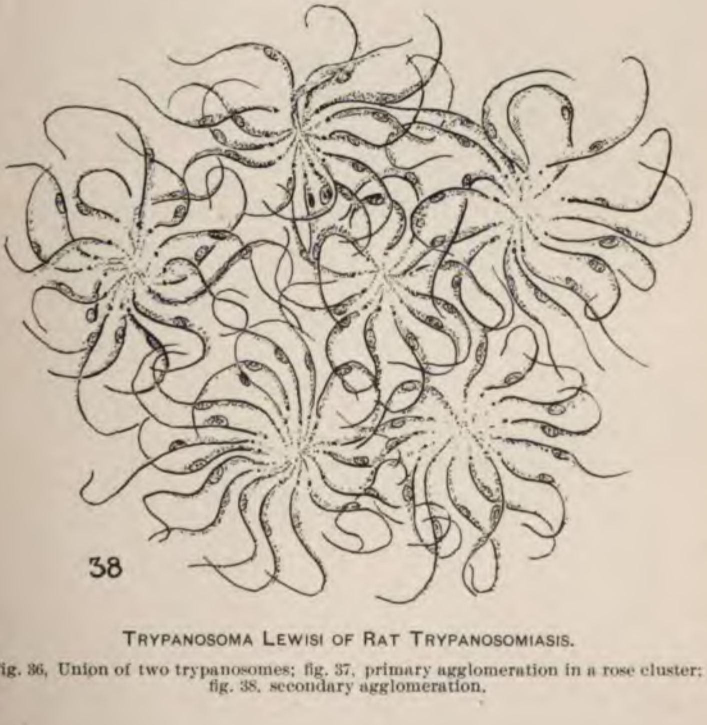
PLATE I.



REPRODUCTION OF TRYPANOSOMA LEWISI IN THE RAT.

PLATE II.





TRYPANOSOMA LEWISI OF RAT TRYPANOSOMIASIS.

Fig. 36, Union of two trypanosomes; fig. 37, primary agglomeration in a rose cluster; fig. 38, secondary agglomeration.

The genus *Trypanosoma* has proved to be very important from the standpoints of comparative medicine and national economics, but its relation to human medicine is at present problematic.

Rats and frogs are the most convenient hosts from which to collect trypanosomes for study. There is quite an extensive literature on the group, the more recent articles containing both bibliographies and technique. The nomenclature, in part at least, does not appear to be firmly established. The following are the best known species:

A. TRYPANOSOMA OF MAMMALS.

Trypanosoma Lewisi[a] (Kent, 1880) **of rat trypanosomiasis.**

(Figures 2–42.)

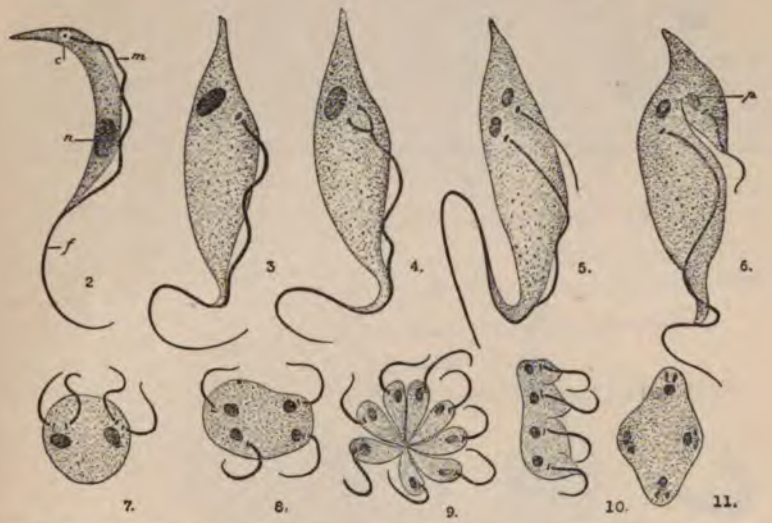


FIG. 2.—*Trypanosoma Lewisi*, completely developed; *n*, nucleus; *c*, centrosome; *m*, undulating membrane; *f*, flagellum. × about 2,000 diameters. (After Laveran & Mesnil, 1901e, p. 686, fig. 1.)

FIGS. 3-6.—*Trypanosoma Lewisi*, in process of division; fig. 6 shows a small trypanosoma on the point of separating from the mother parasite. × about 2,000 diameters. (After Laveran & Mesnil, 1901e, p. 686, figs. 2-5.)

FIGS. 7-10.—Other forms of multiplication of *Trypanosoma Lewisi*. × about 2,000 diameters. (After Laveran & Mesnil, 1901e, p. 686, figs. 6-9.)

FIG. 11.—Multiplying stage, insufficiently stained, so that the flagella are not visible. × about 2,000 diameters. (After Laveran & Mesnil, 1901e, p. 686, fig. 10.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 8 to 10μ long, 2 to 3μ broad; 24 to 25μ long by 1.4μ broad (Laveran & Mesnil, 1901); a very refringent granule (near centrosome) in place of which a clear vacuole is seen in stained preparations. "Animalcules exceedingly minute, attenuate and vermicular under normal conditions, but highly polymorphic and capable of assuming a variety of contours; flagellum single, terminal, two or three times the length of the extended body; no contractile vesicle * * * as yet detected."

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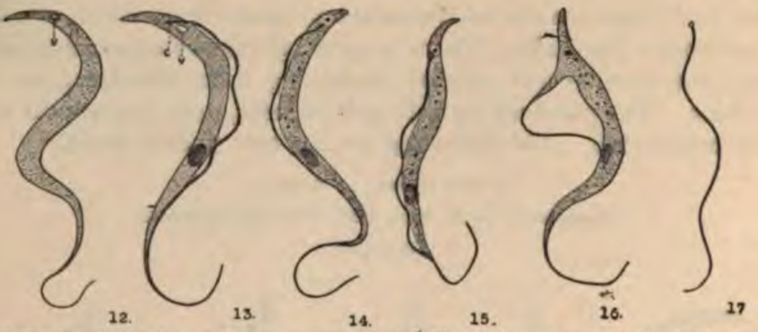
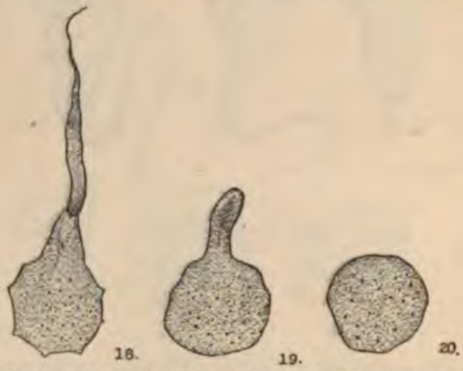
[a] SYNONYMS.—*Herpetomonas Lewisi* Kent, 1880; "*Herpomonas Lewisi* (Kent)," 1880 (lapsus); *Trichomonas Lewisi* (Kent) Crookshank, 1886; *Herpetomonas Lewisii* Danilewsky, 1889; *Trypanomonas murium* Danilewsky, 1889; *Trypanomonas Lewisi* (Kent) Labbé, 1891; *Trypanosoma Lewisi* (Kent); *Trypanosoma sanguinis* Kanthack, Durham & Blandford, 1898 (not Gruby, 1843); *Trypanosoma rattorum* Börner, 1901; *Trypanosoma (Herpetosoma) Lewisi* (Kent) Doflein, 1901.

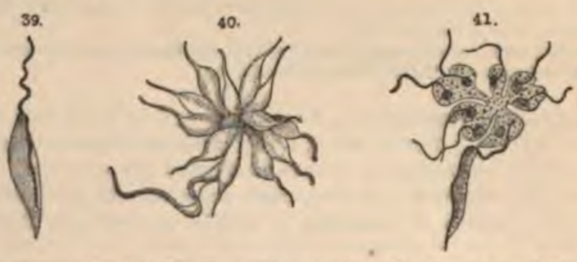
HABITAT.—Blood of rats (*Mus rattus*, *M. decumanus*, *M. rufescens*) and hamster (*Cricetus arvalis*). Fleas, and perhaps lice also, may transmit it from animal to animal.



FIGS. 12-17.—Involution forms of *Trypanosoma Lewisi:* Fig. 12, trypanosoma in fresh blood of the guinea pig; fig. 13, trypanosoma in a colored preparation of guinea pig's blood; *c*, centrosome; *v*, vacuole; figs. 14, 15, trypanosomes colored after being twenty days in the refrigerator; fig. 16, deformed trypanosome, after 9 days in a hanging drop (blood and serum of chicken); fig. 17, centrosome and flagellum, in a colored preparation. (After Laveran & Mesnil, 1901e, p. 688, figs. 11-16.)



FIGS. 18-20.—Leucocyte in the peritoneal exudate of a rat, feeding upon a trypanosome, four hours after the intraperitoneal injection of trypanosomatic blood: Fig. 18, movements of trypanosome are distinct, but somewhat slower; fig. 19, five minutes later; fig. 20, five minutes still later. (After Laveran & Mesnil, 1901e, p. 706, fig. 17.)



FIGS. 39-41.—*Trypanosoma Lewisi:* Fig. 39, simple organism; fig. 40, mass resulting from division, drawn from living specimen; fig. 41, the same, from prepared specimen. (After Senn & Wasielewsky [copied from Doflein, 1901, p. 62, fig. 36].)

LITERATURE.—See especially Lingard's various papers, and Laveran & Mesnil, 1901e, pp. 673–714; Rabinowitsch & Kempner, 1899, pp. 251–294. (See also p. 125.)

There is some doubt as to whether the parasite found in the hamster is identical with that of the rat. Trypanosomes are also reported for other rodents (bandicoots, rabbits, spermophiles, and guinea pigs), but the descriptions are not such that they can be classified with certainty.

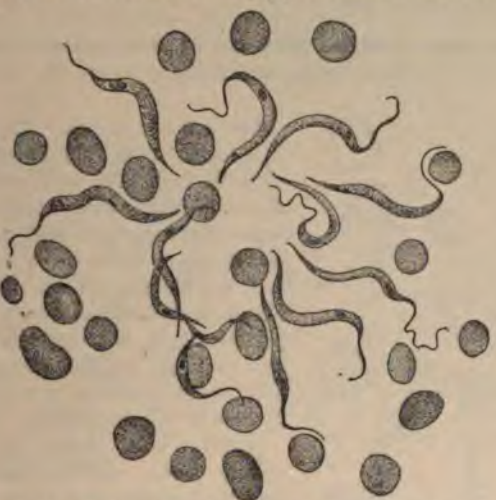


FIG. 42.—*Trypanosoma Lewisi* in rat's blood. "Dissolution of a rosette, with radially arranged developed young." (After Rabinowitsch & Kempner, 1899, pl. 3, fig. 27.)

Trypanosoma Evansi[*] (Steel, 1885) of surra (horses, etc.).

(Figure 43.).

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 20 to 30 μ long, 1 to 2 μ broad.

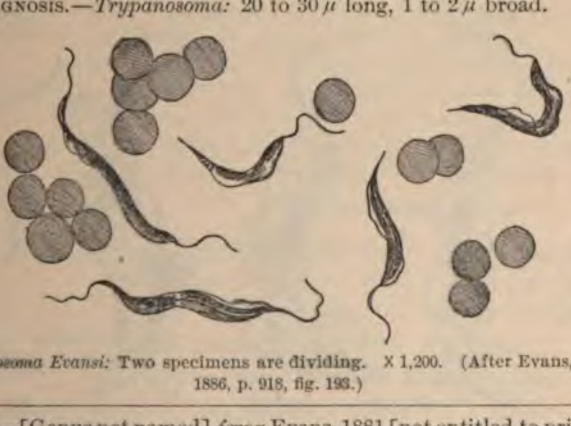


FIG. 43.—*Trypanosoma Evansi:* Two specimens are dividing. × 1,200. (After Evans, in Crookshank, 1886, p. 918, fig. 193.)

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[*] SYNONYMS.—[Genus not named] *ferox* Evans, 1881 [not entitled to priority]; *Spirochæte Evansi* Steel [not accessible]; "*Spirochæta Evansi* Steel," 1885, of Crookshank, 1886; *Hæmatomonas Evansi* (Steel) Crookshank, 1886; *Trichomonas Evansi* (Steel) Crookshank, 1886; *Hemotomonas Evansis* Blanchard, 1888; "*Trichomonas sanguinis* Crookshank" of Balbiani, 1888, p. 399, and Veterinarian, London, 1890, p. 2; "*Spirochetæ Evansii*" of Nariman & Vaz, 1893; "*Spirochæta Evansii* (Steel)" of Laveran, 1895; *Trypanosomum Evansi* (Steel) Chauvrat, 1896; *Trypanosoma Evansi* (Steel) Pease, 1897; *Trypanosoma Evansii* Pease, 1897; *Herpetomonas Lewisii* (Steel) of Danilewsky, 1889; *Trypanosoma* (*Herpetosoma*) *Evansi* (Steel) Doflein, 1901; "*Trichomonas sanguinis Evansi* Crookshank" of Doflein, 1901.

HABITAT.—Blood of horses, mules, camels, and elephants in India; transmissible to cattle, buffaloes, sheep, goats, rabbits, guinea pigs, rats, dogs, cats, and monkeys. Surra may be transmitted by flies.

Trypanosoma Brucii[a] Plimmer & Bradford, 1899, of tsetse disease (horses, etc.).

(Figures 44–49.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 25 to $30\,\mu$ long, 1.5 to $2.5\,\mu$ broad. As compared with *Tr. Lewisi* the posterior extremity of *Tr. Brucii* is not so sharp, the undulating membrane is broader and more plicate, the protoplasm colors more easily and more deeply, and movements are less active. The protoplasm contains granules, which accumulate principally in anterior half, some of which are as large as the centrosome, and they color the same as the centrosome; centrosome divides before the nucleus.

HABITAT.—In blood of African horses, mules, asses, cattle, buffaloes, antelopes, camels, hyenas, and dogs; transmissible to cats, rats, mice, and rabbits, hedgehog, donkey, bosch-bok, hybrid of zebra ♂ × horse ♀, horse ♂ × zebra ♀, ass ♂ × zebra ♀, guinea pigs, goats, sheep, monkey (*Macacus rhesus*), and weasel; cause of nagana, or tsetse-fly disease, and transmitted from animal to animal by the tsetse fly (*Glossina morsitans*). (See also p. 140.)

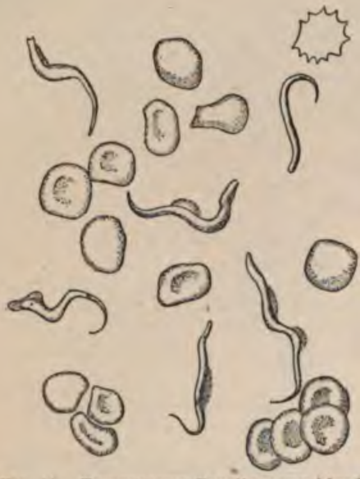
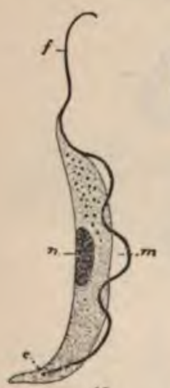


FIG. 44.—*Trypanosoma Brucii* among blood corpuscles. (After Koch, 1898, p. 66, fig. 1.)



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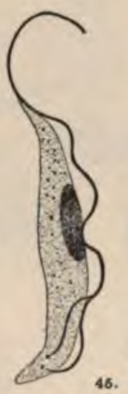

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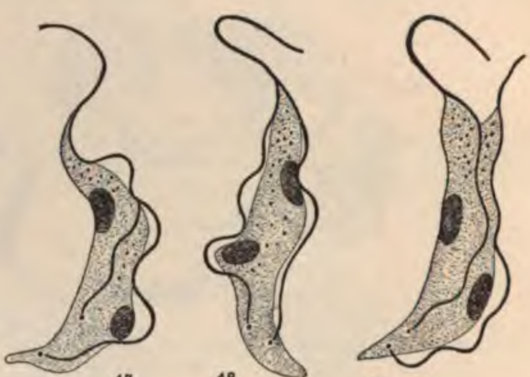

47 48 49.

FIG. 45.—*Trypanosoma Brucii: c*, centrosome; *f*, flagellum; *m*, undulating membrane; *n*, nucleus, × about 2,000. (After Laveran & Mesnil, 1901a, p. 327, fig. 1.)

FIG. 46.—The same, beginning to divide; two centrosomes are present, and the flagellum is now dividing. (After Laveran & Mesnil, 1901a, p. 327, fig. 2.)

FIGS. 47–49.—Further stages of division. (After Laveran & Mesnil, 1901a, p. 327, figs. 3–5.)

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[a] SYNONYMS.—*Trypanosoma Brucii* Plimmer & Bradford, 1899; "*Trypanosoma Brucei*" of Schneider & Buffard, 1900; *Trypanosoma* (*Herpetosoma*) *Brucei* Plimmer & Bradford, of Doflein, 1901, p. 64; *Herpetomonas Brucei* (Plimmer & Bradford) Laveran & Mesnil, 1901.

Trypanosoma equiperdum[a] Doflein, 1901, of dourine (horses, etc.).

(Figures 50–51.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 18 to 26 μ long, 2 to 2.5 μ broad.

HABITAT.—Blood of horse and ass, and transmissible to dogs, rabbits, rats, and white mice. Considered the cause of dourine (maladie du coït; Beschälkrankheit), and transmissible by coitus; Algiers, France, and Spain. Nocard believes dourine is identical with surra and nagana, and doubts exist in the minds of some observers whether *Tr. equiperdum* is actually the cause of the disease.

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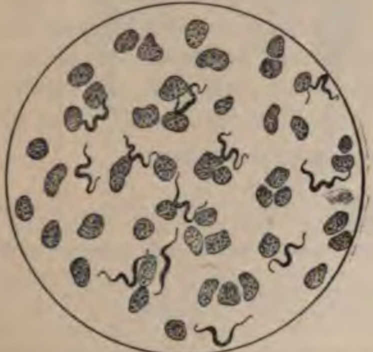

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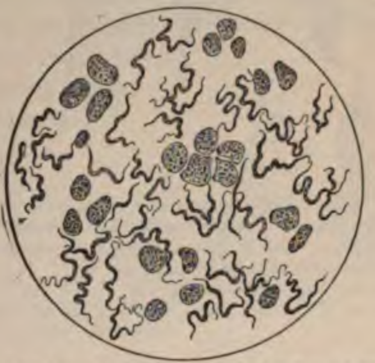

FIG. 50.—*Trypanosoma equiperdum* in blood of a rat, four days after infection. (After Rouget, 1896, p. 722, fig. 2.) FIG. 51.—The same, eight days after infection. (After Rouget, 1896, p. 722, fig. 3.)

Trypanosoma equinum[b] Voges, 1901, of mal de caderas (horses, etc.).

(Figure 52.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* Length 3 to 4 times the diameter of a red corpuscle.

HABITAT.—Blood of horses, mules, asses, hogs, and water hogs; transmissible to white and gray rats and mice, rabbits, guinea pigs (rarely), dogs, goats, sheep, chickens, turkeys, ducks, monkeys (*Nyctipithecus felinus*), and other animals; South America.

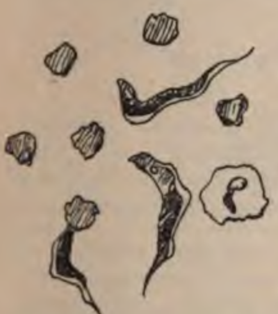

FIG. 52.—*Trypanosoma equinum.* (After Elmassian, 1901, p. 604.)

Trypanosoma sp. of man.

Nepveu (1898) has reported the presence of *Trypanosoma* in man, but satisfactory details are lacking, and the British Medical Journal of January 4, 1902, publishes a short telegram from West Africa, reading: "*Trypanosoma*, European, peculiar symptoms. Dutton." Additional details of Dutton's case are reported in the British Medical Journal, January 11. Further than these three references, we are not acquainted with any original reports relative to trypanosomiasis in man.

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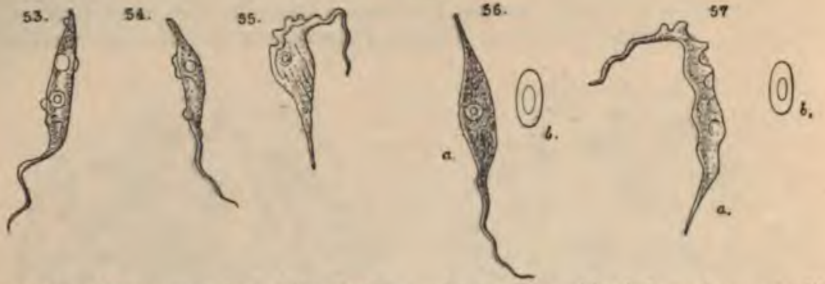
[a] SYNONYMS.—*Trypanosoma* (*Herpetosoma*) *equiperdum* Doflein, 1901, July 1; "*Tryanosoma*" (*Herpetosoma*) *equiperdum* Doflein, 1901 [misprint]; *Trypanosoma Rougeti* Laveran & Mesnil, 1901, July; *Trypanosoma* (*Hæmatomonas*) *equiperdum* Doflein of Lühe, 1902.

[b] SYNONYMS.—*Trypanosoma equina* Voges, 1901; *Trypanosoma equinum* Voges of Railliet, 1901.

B. TRYPANOSOMA OF BIRDS.

Trypanosoma avium[*] Danilewsky, 1885, of avian trypanosomiasis.

(Figures 53-64.)



FIGS. 53-54.—*Trypanosoma avium*, with posterior vacuoles; a nucleus with a halo can be very readily seen in fig. 53. (After Danilewsky, 1889a, pl. 2, figs. 32-33.)

FIG. 55.—A more rare form of *Trypanosoma avium* (with a pectinate surface—*Tr. costatum*). (After Danilewsky, 1889a, pl. 2, fig. 34.)

FIG. 56.—Large *Trypanosoma* (*Tr. major*). (After Danilewsky, 1889a, pl. 2, fig. 36.)

FIG. 57.—The same; entire body undulated. (After Danilewsky, 1889a, pl. 2, fig. 37.)

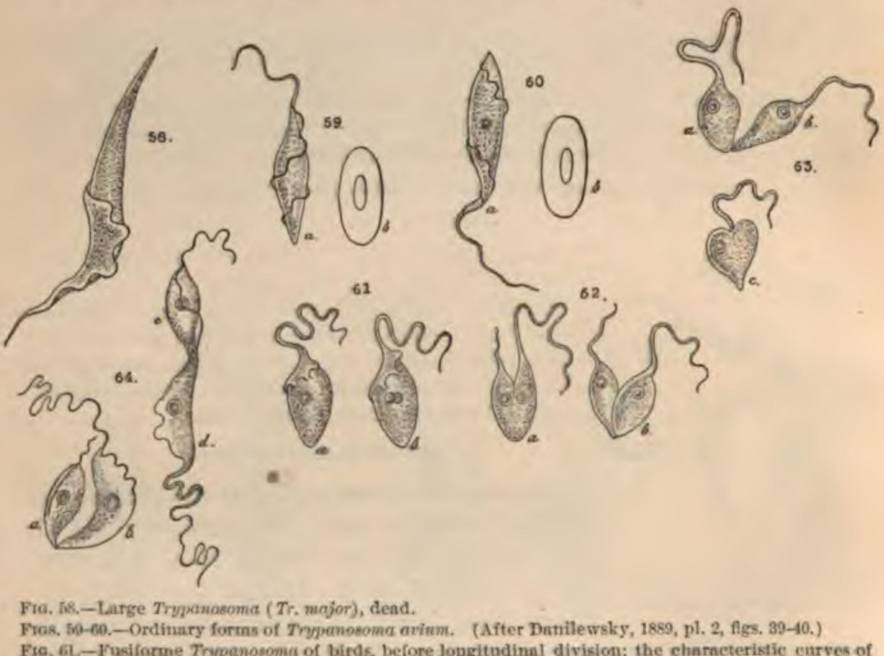


FIG. 58.—Large *Trypanosoma* (*Tr. major*), dead.

FIGS. 59-60.—Ordinary forms of *Trypanosoma avium*. (After Danilewsky, 1889, pl. 2, figs. 39-40.)

FIG. 61.—Fusiforme *Trypanosoma* of birds, before longitudinal division; the characteristic curves of the flagellum; *a*, retraction of the undulating membrane; *b*, division of the nucleus. (After Danilewsky, 1889, pl. 2, fig. 44.)

FIG. 62.—Continuation of 61; division in *a* and *b*; in *a* is formed a new flagellum which elongates rapidly. (After Danilewsky, 1889, pl. 2, fig. 45.)

FIG. 63.—Continuation of 62; division *a* and *b* almost complete; in *a* the mobile flagellum forms characteristic curves, which indicates that the division of the part (*a*) itself is about to take place; *c*, *a*, after the separation of *b*. (After Danilewsky, 1889, pl. 2, fig. 46.)

FIG. 64.—*a*, *b*, Specimens of two young *Trypanosoma avium* after longitudinal division; *a*, a thin hyaline border (which will undulate later), and a young flagellum; *b*, *a*, already an undulating mobile membrane; the undulations start from the root of the flagellum; *c*, *d*, the same *Trypanosoma*, only more developed. (After Danilewsky, 1889, pl. 3, fig. 69.)

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[*] SYNONYMS.—*Trypanosoma avium* Danilewsky, 1885; *Trypanosoma fusiforme* Dani-

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 18 to 60 μ long; body cylindrical, compact, fusiform, and homogeneous; anterior extremity gradually attenuate, and continuing directly into a long or short flagellum; flagellum intimately united with undulating membrane, which extends from flagellum to posterior extremity; nucleus spherical in equator or anterior half of body.

HABITAT.—Blood of birds.

Danilewsky's use of technical names is so confusing and without system that it is often difficult to interpret his writings. Strictly speaking, he does not follow the Linnæan system, and it would perhaps be allowable, under the Code of Nomenclature, to ignore all of his technical names.

? Trypanosoma Eberthi Kent,[a] 1880.

(Figure 65.)

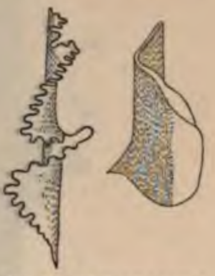

FIG. 65.—*Trypanosoma Eberthi.* (After Eberth [original not accessible, figure copied from Doflein, 1901, p. 59, fig. 33].)

DIAGNOSIS.—*Trypanosoma:* "Body flattened, and semilunate when at rest, its convex membraniform border serrated or presenting a beaded aspect; straight, lanceolate, and pointed at each extremity when in motion, not produced at either end into a tag-like prolongation; the membranous border often spirally convolute around the thicker central portion, the entire body assuming under such conditions an auger-like aspect. Length 1-1760″." (Kent, 1880, pp. 219-220.)

HABITAT.—Cecum and ileum of chickens, ducks, geese, and ? pigeons.

As the genus *Trypanosoma* is composed chiefly of parasites which live in the blood, doubts arise in our minds as to whether this species is correctly classified. Leuckart (1863) based *Sænolophus* upon it.

C. TRYPANOSOMA OF AMPHIBIA.

Trypanosoma rotatorium[b] (Mayer, 1843) Laveran & Mesnil, 1901.

(Figures 66-70.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 40 to 80 μ long by 5 to 10 μ broad; flagellum 10 to 12 μ. "Body compressed, semilunate, twisted; the convex border membranous and undulating; the posterior extremity of the body portion pointed and curved inward, the opposite one produced into a long tag- or tail-like appendage

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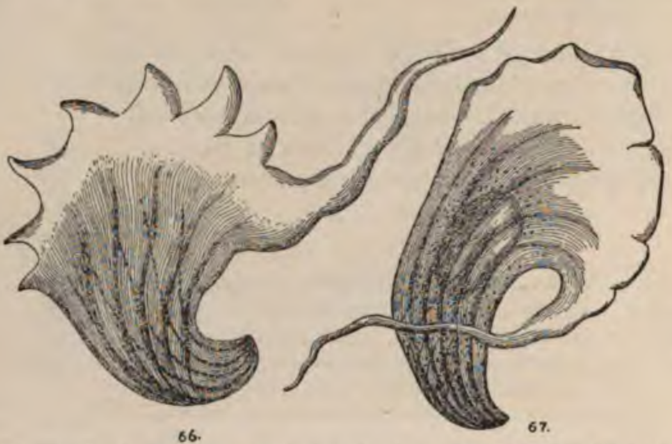
lewsky, 1889; *Trypanosoma minus* Danilewsky, 1889; *Trypanosoma majus* Danilewsky, 1889; *Trypanosoma sanguinis avium* Danilewsky, 1889; *Trypanosoma costatum* Danilewsky, 1889, at least in part; *Trypanosoma major* Danilewsky, 1889.

[a] SYNONYMS.—*Trypanosoma Eberthi* Kent, 1880; "*Tripanosoma Eberthi*" of Lanessan, 1882; ? *Cercomonas gallinarum* Davaine, 1877; ? *Cercomonas gallinæ* Rivolta, 1880; *Tripanosoma Eberthie* of Leclerq, 1890; ? *Trichomonas columbarum* Kruse, 1896.

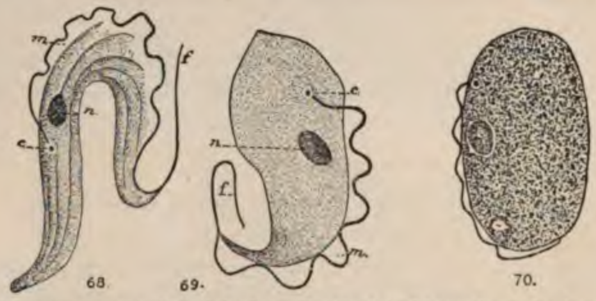
[b] SYNONYMS.—*Amœba rotatoria* Mayer, 1843, July; *Paramæcium loricatum* Mayer, 1843, July; *Paramæcium costatum* Mayer, 1843, July; *Trypanosoma sanguinis* Gruby, 1843, Nov.; *Globularia radiata sanguinis* Wedl, 1850; *Undulina ranarum* Lankester, 1871; *Paramecioides costatum* Grassi, 1881; *Paramecioides costatus* Grassi, 1883; "*Tripanosoma sanguinis* Gruby" of Lanessan, 1882; "*Globularia radiata* Wedl, 1849" of R. Blanchard, 1885; *Trypanomonas ranarum* Danilewsky, 1885; *Trypanosoma ranarum* Danilewsky, 1885; *Trypanosoma renarum* Danilewsky, 1889 [misprint for *ranarum*]; *Trypanosoma costatum* Danilewsky, 1889; *Trypanosoma costatum ranarum* Danilewsky, 1889, p. 61; *Trichomonas ranarum* (Lankester) Danilewsky, 1889; *Trichomonas batrachorum* Danilewsky, 1889; "*Paramoecium loricatum* + *costatum* Mayer" and "*Paramoecioides costatus* Grassi" of Laveran & Mesnil, 1901.

which almost equals in length the remainder of the body; surface of the body coarsely striate longitudinally; endoplasm or parenchyma slightly granular; endoplast ovate, central."

HABITAT.—Blood of frogs (*Rana temporaria*, *R. esculenta*, *Hyla arborea*).



FIGS. 66-67.—*Trypanosoma rotatorium*. (After Lankester, 1871, p. 388, figs. 1-2.)



FIGS. 68-70.—*Trypanosoma rotatorium* of the frog: Fig. 68, plaited form; fig. 69, flat form; *c*, centrosome; *f*, flagellum; *m*, undulating membrane; *n*, nucleus; fig. 70, retracted. X about 1,400 diameters. (After Laveran & Mesnil, 1901c, p. 680, figs. 1-3.)

D. TRYPANOSOMA OF FISH.

Trypanosoma cobitis[a] **(Mitrophanow, 1883) of the loach, or mudfish.**

(Figure 71.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 30 to 40 μ long, 1 to 1.5 μ broad; flagellum 10 to 15 μ. "Body provided with a spiral membrane and a flagellum at the fore end. Parenchyma of body homogeneous. Second variety, body and flagellum only. Movement undulatory, body containing highly refractive spherules. Third variety, plasma-like body, without membrane or flagellum; quickly changes form by sending out processes laterally, and contains two to four refractive spherules." (Crookshank, 1886, pp. 921–922.)

HABITAT.—Blood of the mudfish (*Cobitis fossilis*).

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[a] SYNONYMS.—*Hæmatomonas cobitis* Mitrophanow, 1883; *Trichomonas cobitis* (Mitrophanow) Crookshank, 1886; *Trypanosoma piscium* Danilewsky, 1885, in part; *Trypanosoma fusiforme piscium* Danilewsky, 1885, in part; *Trypanosoma* (*Herpetosoma*) *cobitis* (Mitrophanow) of Doflein, 1901; *Hæmatomonas cobitidis* Lühe, 1902.

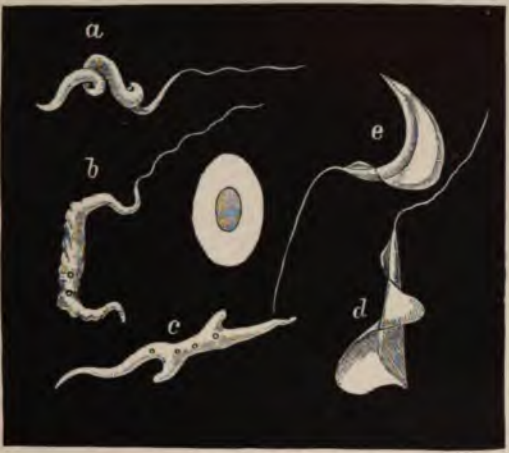

FIG. 71.—TRYPANOSOMA COBITIS IN THE BLOOD OF MUDFISH.

a, First variety; *b*, second variety; *c*, third variety; *d*, first variety in a state of diminished activity; *e*, the same after treatment with osmic acid. (After Mitrophanow, 1883, p. 41, fig. 1.)

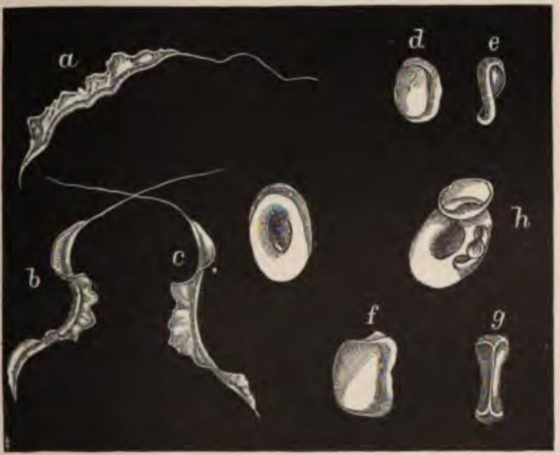

FIG. 72.—*a*, *b*, *c*, TRYPANOSOMA CARASSII IN THE BLOOD OF THE CARP; *d*, *e*, *f*, *g*, *h*, OTHER ORGANISMS IN THE SAME BLOOD.

(After Mitrophanow, 1883, p. 42, fig. 2.)

Trypanosoma carassii[a] (Mitrophanow, 1883).

(Figure 72.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* "Long bodies, with narrow membrane attached along the whole length; less actively motile. Several forms also observed strikingly smaller than the above; many disk-shaped. Often seen attached to a red corpuscle, setting them in motion by their movements." (Crookshank, 1886, p. 922.)

HABITAT.—Blood of fish (*Carassius vulgaris*).

Trypanosoma Remaki Laveran & Mesnil, 1901, of pike.

(Figures 73–74.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* Noticed in two forms, described as varieties as follows:

Trypanosoma Remaki parva Laveran & Mesnil, 1901: Very similar to *Tr. Lewisi;* 28 to 30 μ long, including flagellum which is about as long as the body; 1.40 μ broad; body pointed at both extremities, often more pointed anteriorly; protoplasm finely granular; nucleus round or oval, usually near border between anterior and middle thirds of body; "centrosome" small, spherical, near posterior extremity; undulating membrane slightly developed.

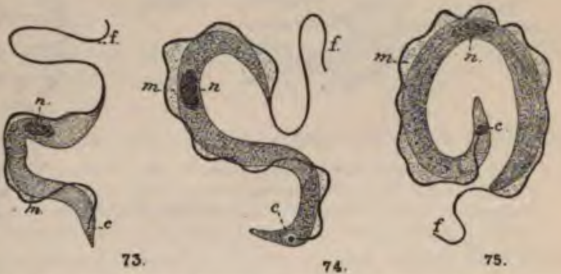

FIG. 73.—*Trypanosoma Remaki parva;* c, centrosome; f, flagellum; m, undulating membrane; n, nucleus. × about 1,800. (After Laveran & Mesnil, 1901, p. 672, fig. 1.) FIG. 74.—*Trypanosoma Remaki magna.* (After Laveran & Mesnil, 1901, p. 672, fig. 2.) FIG. 75.—*Trypanosoma soleæ;* c, centrosome; f, flagellum; m, undulating membrane; n, nucleus. × about 1,800. (After Laveran & Mesnil, 1901, p. 672, fig. 3.)

Trypanosoma Remaki magna Laveran & Mesnil, 1901: 45 μ long, including flagellum, the body measuring 26 to 28 μ long, 2 to 2.5 μ broad; thicker than *Tr. Remaki parva* and colors more intensely.

HABITAT.—Blood of European pike (*Esox lucius*).

Trypanosoma soleæ Laveran & Mesnil 1901, of soles.

(Figure 75.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* Body 32 μ long, flagellum 8 μ long; anterior extremity often less pointed than the posterior; oval nucleus, containing large granules of chromatin, situated near equator; "centrosome" spherical, larger than in *Trypanosoma Remaki*, and situated toward posterior extremity; undulating membrane well developed.

HABITAT.—In blood of soles (*Solea vulgaris*); France.

E. ? TRYPANOSOMA OF MOLLUSKS.

? Trypanosoma Balbianii[b] Certes, 1882, of oysters.

(Figures 76–81.)

SPECIFIC DIAGNOSIS.—*? Trypanosoma:* 50 to 18 μ long by 1 to 30 μ broad.

HABITAT.—Intestine of oysters (*Ostrea edulis, O. angulata, Gryphæa angulata*) and mussels (*Tapes decussata, T. pallustra*).

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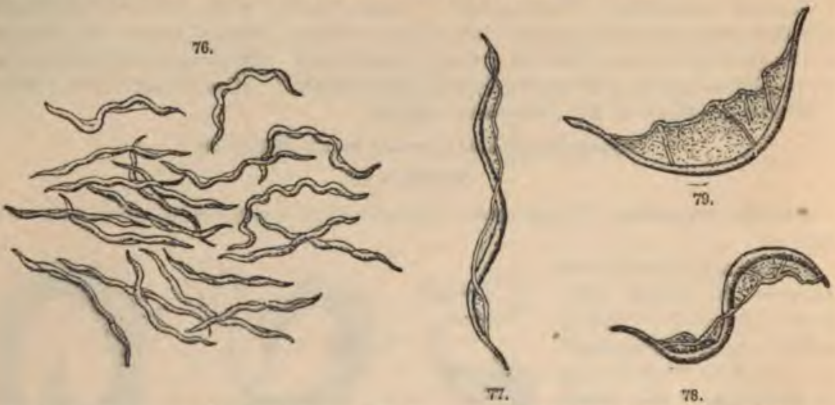
[a] SYNONYMS.—*Hæmatomonas carassii* Mitrophanow, 1883; *Trichomonas carassii* (Mitrophanow) Crookshank, 1886; *Trypanosoma piscium* Danilewsky, 1889, in part; *Trypanosoma fusiforme* Danilewsky, 1889, in part; *Trypanosoma* (*Herpetosoma*) *carassii* (Mitrophanow, 1883) Doflein, 1901, p. 71.

[b] SYNONYMS.—*Trypanosoma Balbianii* Certes, 1882; *Tripanosoma Balbianii* (Certes) Balbiani, 1888; "*Trypanosoma Balbiani*" of Danilewsky, 1889, p. 55.

According to recent investigations by Laveran & Mesnil (1901f), this parasite is not a member of the family Trypanosomidæ.



FIGS. 76-79.—*Trypanosoma Balbianii* Certes: Fig 76 group of living individuals submitted to compression; X 250; retractile crest seen in a certain number of individuals; fig. 77, living individual compressed and colored by methylene blue; X 800; crest quite visible; figs. 78-79, individuals fixed by the vapors of osmic acid, and colored by methylene blue; X 800. (After Certes, 1882, pl. 7, figs. 1-4.)

Genus Trypanoplasma[a] *Laveran & Mesnil, 1901.*

GENERIC DIAGNOSIS.—Trypanosomidæ: Body elongate, provided with a longitudinal lateral membrane, and terminating at each end with a flagellum.

TYPE SPECIES.—*Trypanoplasma Borreli* Laveran & Mesnil, 1901.

Trypanoplasma Borreli Laveran & Mesnil, 1901.

(Figure 82.)

SPECIFIC DIAGNOSIS.—*Trypanoplasma:* 20 μ long (flagella not included), 3 to 4 μ broad; body flattened, often curved in an arch, concave side thicker than the convex side which bears the undulating membrane; anterior extremity pointed, posterior extremity rounded; at union of middle and posterior thirds of body are seen two masses of chromatin of about equal size and of elongate form, their long axis parallel with longitudinal axis of the body; the mass on the concave side of the body is interpreted as the nucleus, that on the

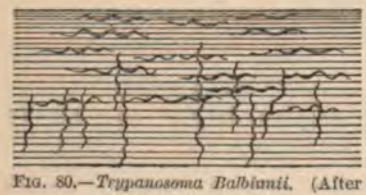


FIG. 80.—*Trypanosoma Balbianii.* (After Certes, 1891, p. 131.)

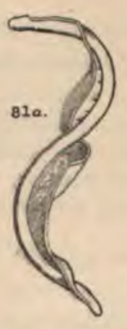


FIG. 81 *a*.—*Trypanosoma Balbianii.* (After Lustrac, 1896 [copied from Doflein, 1901, p. 60, fig. 34a].)

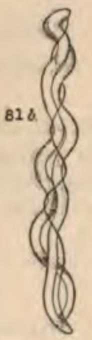


FIG. 81 *b*.—The same, dividing. (After Lustrac, 1896 [copied from Doflein, 1901, p. 60, fig. 34 b].)

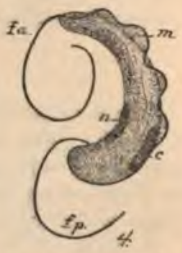


FIG. 82.—*Trypanoplasma Borreli;* *c*, centrosome; *fa*, anterior (major) flagellum; *fp*, posterior flagellum; *m*, undulating membrane; *n*, nucleus. X about 1,800. After Laveran & Mesnil, 1901, p. 672, fig. 4.)

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[a] SYNONYMS.—"*Trypanomonas* Danilewsky" of Labbé, 1891; "*Trypanosoma* (*Trypanomonas*)" of Doflein, 1901; *Trypanoplasma* Laveran & Mesnil, 1901.

convex surface as the "centrosome;" from the "centrosome" extend two flagella, one anteriorly, the other posteriorly; the anterior flagellum borders the undulating membrane, then becomes free; the posterior flagellum borders the convexity of the posterior portion of the body (where there possibly exists an undulating membrane much less developed than the membrane of the anterior portion) then borders the posterior extremity of the body, then suddenly turns on itself and becomes free; flagella, each about 15 μ long, making the total length of the parasite about 50 μ.

HABITAT.—Blood of the redeye (*Leuciscus erythrophthalmus*); France.

Trypanoplasma Danilevskyi[*] **(Labbé, 1891).**

(Figure 83.)

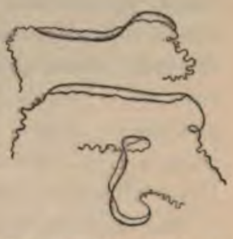

FIG. 83.—*Trypanoplasma Danilevskyi.* (After Labbé, 1891, p. 230.)

SPECIFIC DIAGNOSIS.—*Trypanoplasma:* 15 to 20 μ long, scarcely 1 μ broad; body elongate, filiforme.

HABITAT.—Intestine of leeches; France.

It is more than possible that this parasite was taken in with the blood of some vertebrate.

TECHNIQUE.

Examine fresh or defibrinated blood. Also, spread blood in a thin layer on a cover-slip, allow it to dry superficially, then fix in absolute alcohol 1 to 2 minutes, and color for 3 to 5 minutes in dilute methylene blue.

Doflein recommends for permanent preparations the same method used for amebæ, or Ziemann's modification of Romanowski's method. The following staining fluids are mixed in a watch glass just before using:

	Grams.
1. One part of the mixture—	
Methylene blue	1
Borax	2.5
Distilled water	100
2. Four parts of the mixture—	
Eosin	.1
Water	100

"This mixture colors in about 10 minutes, and in many cases very nicely differentiated, in that the plasma appears blue, flagella red, and chromatin also red, but of a different shade. If one of the two colors is too intense, place the cover slip in the other color for a short time." Then treat the preparation in the usual way, finally making a balsam mount.

Laveran & Mesnil (1901e) recommend highly the following method:

(1) The blood is spread in a thin layer on a slide, dried rapidly, and fixed in absolute alcohol for 10 to 15 minutes.

(2) The following solutions are prepared in advance: (a) Methylene blue with silver oxide or Borrel blue. Into a phial of about 150 c. c.

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[*] SYNONYMS.—*Trypanomonas Danilevskyi* Labbé, 1891; *Trypanosoma* (*Trypanomonas*) *Danilevskyi* (Labbé) Doflein, 1901.

are placed a few crystals of nitrate of silver and 50 to 60 c. c. of distilled water; when the crystals are dissolved the phial is filled up with a solution of soda, and the whole is shaken; there is formed a black precipitate of oxide of silver, which is repeatedly washed in distilled water, so as to remove the nitrate of soda and the excess of soda; then upon the silver oxide is poured a saturated aqueous solution of methylene blue, prepared with Höchst's medicinal methylene blue. These are left in contact for about two weeks and shaken repeatedly; (b) 1 per cent aqueous solution of eosin (eosin soluble in Höchst's water); (c) 5 per cent solution of tannin.

The staining mixture is prepared *when one is ready to use it* according to the following formula:

	Cubic centimeters.
1 per cent eosin solution	4
Distilled water	6
Borrel blue	1

The slide upon which the blood has been spread and fixed is immersed in the staining mixture which has been poured into a Pétri dish, for example, and it is left there from 20 to 30 minutes.

Upon being removed from the bath the preparation is washed very freely with water, then treated with the tannin solution (10 to 15 minutes); it is then washed again freely with water, and then with distilled water, after which it is dried.

When there has formed a precipitate that is a hindrance in the examination, the preparation is washed with essence of cloves, then with xylol, and a fine cloth saturated with xylol is passed over the surface of the preparation. The preparations are better preserved dry than in balsam, and especially better than in cedar oil, in which they rapidly lose their color.

When the staining has been successful, the protoplasm of the *Trypanosoma* stains light blue, the nuclei stain violet and also the centrosomes and the flagella, in their free portion as well as in the part which borders upon the undulating membrane; the undulating membrane remains colorless or takes on a very pale bluish tinge. The blood corpuscles are stained pink, and the nuclei of the leucocytes deep violet.

SOURCE OF INFECTION BY THE PARASITE OF SURRA.

Opinions differ as to source of infection. While the drinking water and herbage, and grain containing feces of rats and bandicoots have been viewed with suspicion by prominent authorities, some authors suspect that flies of the family Tabanidæ act as transmitters of the organism. This latter view is strongly supported by analogy, for tsetse disease, which also is caused by a trypanosome (*Trypanosoma Brucii*) and which some authors look upon as nearly if not quite identical with surra, is carried by the tsetse fly (*Glossina morsitans*), and *Trypanosoma Lewisi* of rats has been shown to be transmitted by fleas, while lice also may disseminate this same parasite.

Lingard (1899, p. 74), in discussing the methods of infection, assumes "that animals (equines, bovines, solipeds, and buffaloes) acquire surra by the entrance of the *Trypanosoma* into their systems in one of four ways—

"(1) From eating grass and vegetation grown upon land subject to inundation.

"(2) From drinking stagnant water during certain months of the year.

"(3) From the bite of certain species of flies, probably as carriers of the virus.

"(4) From the ingestion of corn soiled with the excrement of the rat and bandicoot."

Of these methods it seems to us that the insect theory is by far the most plausible.

A. FROM THE BITE OF OR INFECTION BY INSECTS AS CARRIERS OF THE PARASITES.

Lingard (1899, p. 75) demonstrated in 1891 that the "body fluids" of certain flies, after sucking the blood of surra animals, contained *Trypanosoma* in varying numbers, and, further, that healthy animals when inoculated with such soiled material contracted the disease after a period of incubation. These facts, taken in connection with the recent experiments on nagana and on rat trypanosomiasis, indicate very strongly that Evans's surra is transmitted by dipterous insects. Lingard mentions *Tabanus* (gadflies), Hippoboscidæ (louse flies), Muscidæ (flies), and Culicidæ (mosquitoes) as bothering the animals in India. He quotes the following (1899, p. 78) from "Nawabkhan, the camel jamadar of the Third Punjab Infantry," who "has the reputation of knowing more about the camel than anybody else in the district:"

"The prevailing opinion among the natives in this district is that surra is caused by the bite of a large brown fly (the size of a small bee) called *Bhura dhang*. In the month of May that fly comes from the ground in jungle land that has been under water. In June and July the flies are very numerous and in full force; about the 15th of August they begin to diminish, and early in October they are obtained with difficulty. The fly bites horned cattle and donkeys, but these suffer no ill effects; it bites men, and a painful swelling follows; it bites horses and camels, and gives them a fatal disease known by several names, such as *khanhog*, *doaia*, and *surra*, depending upon the several stages. *Phipri* is another name by which it is known among camels. I know of no reason for saying that the fly causes the disease except the common tradition of my people." (Griffith Evans, 1880.)

Lingard (1899, pp. 22, 78–79) further states:

"*Flies.*—On the 24th of September at Mohand I demonstrated microscopically the surra hæmatozoon in the blood of flies taken from the bodies of horses suffering from the disease, in the blood of which the protozoon was present at the time.

"The presence of the *Trypanosoma* of surra in the body fluids of certain species of flies caught near to or on the bodies of animals (horses, dogs) suffering from that disease was frequently observed and demonstrated at the Poona Laboratory in

1890. We have before pointed to the fact that when once the disease exists its further development in other animals is frequently due to the bite of flies, which carry the soiled blood on their piercing organs.

"The chief question which presented itself for solution was whether the *Trypanosoma* is ever to be found in the body fluids of flies and ticks (1) during the hot season of the year, when it is very exceptional to find a case of the disease, or (2) during the early part of the rains before the disease has manifested itself in animals. In order to elucidate the above problems it was necessary to visit the localities known to be surra centers during the hot season, but just before the rains usually commence at the end of May and beginning of June, and a second time about the end of August and beginning of September, the middle of the rains, on each occasion to systematically make a very large number of microscopical observations of the different fluids to be examined.

"With this object in view (1) in the hot season, numerous specimens of the thoracic and abdominal fluids of the following species of Diptera were submitted to microscopical examination: (*a*) Large green-headed fly (*Tabanus lineola*), (*b*) large brown-headed fly (*Tabanus tropicus*), (*c*) horse and cattle fly (*Hippobosca maculata*), (*d*) small variety infesting dogs (*Hippobosca*), (*e*) local varieties of the Muscidæ, and (*f*) mosquitoes (Culicidæ).

"Flies obtained from every available source were submitted to microscopical examination. During a sojourn in a surra locality we engaged coolies to supplement our own staff; consequently fresh supplies of Diptera were brought in several times daily. These were carefully examined in the fresh state. In different districts one or more species of flies were generally found to predominate, but they varied also in number and species according to the season of the year.

"The microscopical examination of the water, mud, fresh-water shellfish, flies, and ixodes collected during the hot season observations failed to reveal the presence of any form of *Trypanosoma*.

"(2) During the rainy season tour, hundreds of flies belonging to some ten different species, together with ticks from equines and canines, were collected and their body fluids submitted to microscopical examination, but in all cases with negative results as regards the presence of the *Trypanosoma*.

"Veterinary Capt. G. H. Evans, during his tours in Burma, has been good enough to make a large number of microscopical observations for this report, but has failed to detect anything like the surra hæmatozoon in the jungle Diptera examined. He states that a fly exists in Burma, a little larger than the common house fly, with body yellowish in color and with its legs bent on themselves. At the point where this fly bites a small extravasation of blood appears just under the skin, which shortly after presents the appearance of a blood bleb, such as follows a contused wound. These insect pests are present in great numbers just before thunderstorms at the termination of the hot season, not only in the plains, but also at Thandaung in the Karen and Binjyi in the Shan Hills. The gaur (Indian bison) and tsaing suffer from rinderpest and foot-and-mouth disease, yet these animals have, up to the present, never been observed with surra, although careful search for the disease has been made. They live in heavy jungle where the flies are so annoying to them that they have to go in the open to escape their attacks."

Griffith Evans (1881, p. 8), in his excellent discussion, appears to be the first European to suggest flies as transmitters of surra. He says:

"It is not improbable, however, that those flies so excessively troublesome at Jutta and other outposts, which bite horses so that the blood streams down the legs as if it had been squirted on, do convey the disease from one horse to another by inoculation. It is a fact that the disease does spread mostly at those posts where the horses are closely packed and the flies are in greatest numbers; but those are

> the posts also where the drinking water is worst; so that it is extremely difficult to form a true opinion upon this subject without further experiments. However, the indications at present are that horses affected with surra should be kept at a distance from other horses during the season when those flies are common. They were becoming scarce in the early part of October. I obtained two specimens with difficulty. I do not know yet what is their scientific name. They are very large, of a brown color, and common in many parts of India. The natives call them bhura dhung, which means a great needle-like sting. There is a common opinion prevailing among the natives of the Dera Ismail Khan district that this fly is the cause of the disease. I shall refer to this again, and merely mention it here because I think the fly may sometimes propagate the disease by inoculation, and thus be an item among the causes to account for the spread of the disease more at some posts and in some years than others, though the disease would exist independently of them. When the horses stand close together the fly is able to go from one horse to another before the blood about its mouth is dry; whereas if he had to travel some distance through the dry air, in the hot sun, the virus of the blood would perhaps be destroyed."

Pease (1897, p. 560) says that the natives have for years attributed surra to *Tabanus tropicus.*

The fly theory of surra explains satisfactorily a number of facts which have long been observed in connection with this malady. Thus, surra is a disease of wet weather, and, as we have already pointed out, biting flies are practically creatures of moisture. They breed more rapidly in wet weather, and pupæ are more likely to issue when the surrounding media are moist than when they are dry. Howard,[a] in discussing the Tabanidæ, says:

> "The adults are great water drinkers, and are usually most abundant in the vicinity of inland ponds and streams. This has suggested to Porchinsky, the Russian entomologist, the desirability of coating such ponds with kerosene, and his experiments resulted in the destruction of great numbers of Tabanids.
>
> "The larvæ of the Tabanidæ live in the earth or in water and are carnivorous, feeding upon soft-bodied insects and water snails. The spindle-shaped brown or black eggs are deposited in summer in groups attached to the leaves or stems of herbage. The gadflies vary greatly in color and size, and the smaller ones of the genus *Chrysops*, sometimes called 'deer flies,' are frequently quite small and colored with yellow or green. The larger ones vary through gray and brown to black. Our largest gadfly is *Tabanus americanus* Först., which is 1¼ inches long, and has a wing spread of 2½ inches. It inhabits the Southern States. About 1,500 species are known, and perhaps 200 occur in this country."

The importance of moisture in connection with biting flies in general is also ably set forth by Miss Murtfeldt[b] in the following passage:

> "The horsefly,[c] very numerous and annoying to cattle during May and June, entirely disappeared some weeks since, the manure drying out too rapidly to afford the larvæ time to develop. Even the housefly and other annoying Muscidæ are comparatively few in number."

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[a] The Insect Book, 1902, pp. 131–132. New York.

[b] Drought, Heat, and Insect Life, by Miss Mary E. Murtfeldt, Bull. 31, n. s., Div. Entom., U. S. Dept. Agric., 1902, pp. 97–99.

[c] Reference is apparently made to *Stomoxys calcitrans.*

George H. Evans (1899, p. 41) states that in Burma flies are particularly bad after the first few thunderstorms. Again, surra is acknowledged to be more common in moist places, as near rivers, ponds, and marshes. In this connection it may be pointed out that flies also are more common in such localities.

Nariman & Vaz (1893, p. 403) are authority for the statement that there is a common belief among natives that animals acquire surra by eating filth from the refuse heaps outside of the villages. This belief also supports the fly theory, for refuse heaps attract flies, and on this account there would be a greater chance of infection when horses feed around such heaps.

Pease (1897, pp. 557–558) has stated that he has seen all the dogs of a village infected from eating the carcasses of animals which died of surra, and that cats become infected in the same way. It seems to us, however, that it is perhaps an open question whether the dogs were actually infected through eating the meat or whether the carcasses had attracted flies which in turn had bitten the dogs. Both explanations seem plausible, for the parasites might enter the dogs through some wound in the mouth, such as could easily be made while gnawing bones.

Rodgers (1901, p. 164) has recently experimented with the transmission of surra by flies. In every case where they were kept from one to four or more days after biting an infected animal no disease developed when these flies bit healthy animals; but fresh flies—that is, immediately after biting infected animals—produced infection in healthy animals. No developmental stages of the parasite were found in the tissues of flies, and such insects fed to a rat failed to produce infection.

The fly theory also agrees entirely with experimental subcutaneous inoculations. It has been abundantly demonstrated by various observers that surra may be transmitted by subcutaneous injection, and also that horses contract surra readily in the usual period (5 to 7 days) when a small scratch on the muzzle is smeared with a trace of soiled blood. The bite of a fly or the soiling of a scratch by a fly whose beak, body, or legs are soiled with undried trypanosomatic blood corresponds to these cases of experimental infection.

It is very noticeable that in speaking of prevention, a number of authors advise removing the animals to more healthful ground, and it seems quite reasonable to assume that such a change would naturally be to a region where flies are less common.

Finally, Steel (1886a, p. 170) records that gray and white mules suffer most, and in this connection we may point out the fact that, according to Professor Wallace, flies attack light-colored animals more than they do dark ones. Whether they actually do attack lighter animals more, or whether they are only seen more easily on a light background, is perhaps an open question. There can, however, be little doubt that certain mosquitoes attack whites more than they do negroes, and the apparent relation between the white and gray mules, the flies, and surra, is, to say the least, a tempting explanation.

We are by no means convinced as yet that biting insects play any *necessary* rôle in the life history of *Trypanosoma* comparable to the rôle mosquitoes (of the genus *Anopheles*) play in the sexual generation (sporogony) of *Plasmodium*, the cause of malaria. Up to the present time far too little is known regarding the variations in the life cycle of the Trypanosomidæ to warrant any but the most reserved conclusions, but the indications, to our minds, are that whether or not the parasite of surra *may* pass a sexual stage of reproduction in *Tabanus* (gadflies), such a sexual stage does not appear to be necessary for the dissemination of the disease by insects. In other words, the indications seem to be in the line of the explanation given by Griffith Evans (1881, p. 8), namely, that flies with undried surra blood on their beaks may transmit the disease. If these indications have been correctly interpreted by us, consistency would compel us to admit that not only *Tabanus tropicus*, but any other biting or piercing insect, such as *Stomoxys calcitrans*, and even the ordinary housefly (*Musca domestica*), might act as transmitters. Accordingly, we at present are inclined to believe that if by any chance a surra patient were brought to this country, the disease could spread here, even if no Asiatic insects were accidentally introduced at the same time. In other words, our American biting flies, and even mosquitoes, must be taken into consideration as possible or even probable disseminators of the contagious material.

Some flies which Dr. J. J. Curry, of the medical corps of the United States Army, collected in the Philippines have been forwarded by him to Dr. L. O. Howard, entomologist of the United States Department of Agriculture, and have been determined as the common biting stable fly, *Stomoxys calcitrans*. Dr. Curry states that he collected the specimens in question from surra horses, and that in his opinion this is the fly which is the common transmitter of the disease in the Philippines. He has repeatedly found the surra parasite in the stomach and in the proboscis of this *Stomoxys*, but we are not informed that any direct experiments have been made to transmit surra by means of the insect in question.

B. BIRDS AS POSSIBLE TRANSMITTERS OF SURRA.

Lingard (1899, p. 22) also mentions the possibility of the accidental transmission of surra by crows. He says:

> "Several instances presented themselves where both healthy and diseased horses were standing side by side; both classes of animals presented open sores (galls) on their bodies, generally on either side of the spinal column. Crows were perched on their backs, pecking and scratching the sores, and in several instances drawing blood.

The birds moved freely from the back of one animal to the other, and no doubt this is one source by which the disease is spread. This would occur with the greatest ease either with their blood-stained beaks or with their soiled feet coming in contact with a raw surface, for I have proved that a minute fraction of a drop of blood containing surra hematozoon is capable of conveying the disease to the horse if spread over a scratch in the skin of the animal."

We see nothing improbable in this view. In fact, surra appears to us to be a wound disease, transmissible through any sort of wound, whether it be made by insects, crows, syringes, knives, or anything else, provided undried trypanosomatic blood comes in contact with the freshly wounded surface.

C. INFECTION BY INGESTION OF BLOOD OF AFFECTED ANIMALS.

A number of experiments have been made to transmit surra to animals by feeding the blood of infected animals, and attention has already been directed to the statement that dogs and cats are alleged to become infected through eating surra carcasses. We are inclined to accept this as a possible method of transmission, but in this connection we would direct attention to the following points:

(1) It does not appear to be satisfactorily demonstrated (*a*) whether the parasites have forced their way through the intestinal mucosa (as does not seem impossible: Compare bacterial infections; tuberculosis; trichinosis; *Balantidium coli*, according to Strong's recent interesting results); or, (*b*) whether the hematozoa have entered the system through some intestinal wound. (2) It also does not appear in the ingestion experiments that authors have always excluded the possibility of accidental infection by insects. Infection by ingestion of blood does not at present come into very serious consideration in connection with the transmission of surra from horse to horse, unless perhaps the horses should lick fresh, bleeding fly bites, and thus accidentally smear a wound in the mouth with trypanosomatic blood.[a]

D.? CONGENITAL INFECTION.

According to Lingard (1895, p. 12), no *Trypanosoma* has been found in the fetuses in case of rats, even when the gravid mother was found infected. This conclusion is based upon a number of observations, and apparently establishes the fact that, at least under normal conditions of the placenta, surra is not congenitally infectious. (See also pp. 141, 158.) This view is supported by other authors also.

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[a] An article has just been obtained from Rodgers (1901), who shows (p. 168) that, if surra blood is fed to an animal with an abraded surface with which the blood comes in contact, infection will take place. If there is no abrasion, no infection follows.

E.? FROM DRINKING STAGNANT WATER AND EATING VEGETATION GROWN UPON LAND SUBJECT TO INUNDATION.

In discussing infection from these sources, Lingard (1899, pp. 74–75) says:

> "The question of grass and water being the carriers of the contagium of surra is so intimately associated that it will be as well to consider these two factors together in their relation to the causation of the disease. The distribution of this malady seems to be entirely influenced by the physical aspect of the country. It appears to be chiefly brought about by the occurrence of floods and inundations, being far more prevalent in those parts of the country where these occur than in the higher and drier portions. It is far more common in the vicinity of the rivers and canals than in portions of the country where water is scarce. It is not usual for the natives of India to make any provision for the maintenance of their animals in the form of hay or dried grass. The usual custom is either to graze their cattle where grass is to be found or to cut it from the jungles and wastes as it is required. Toward the end of the hot season grass on the higher lands has become burnt up; at lower levels, especially at the bottoms of nalas, swamps, and ponds, where water has been lying till a much later period, an abundant supply can generally be found, and it is from these sources that it is procured.
>
> "Similar conditions operate at intervals during the wet season, or directly the rains have ceased, especially in those parts of this country where the temperature is high at this time of the year. The lands bordering on rivers and streams, or those which are low lying, become flooded, the herbage is covered with water, which in some cases, when the land has a clayey subsoil, disappears almost entirely by gradual evaporation, and such places are favorable for the development of low forms of life, and possibly for the *Trypanosoma*. Animals, therefore, which daily consume grass and drink water from such localities run a risk of taking into their systems the contagium of this disease. In confirmation of these statements we may mention one example from many collected. The inhabitants of a village "Naoni" in the Ghaziabad Tahsil, of the Meerut district, visited by Veterinary Captain Pease in 1895, informed him that some 40 out of 60 camels attacked had died out of a herd of 250. The people now drive the camels away to the Bangar or higher lying grounds during the rains, and water those animals which remain in the lowlands from wells only, in order to escape the disease. They attribute the disease to stagnant water, and do not allow their camels to drink at open places until the water has stood for a considerable time and become 'pakka' (wholesome). On the other hand, Veterinary Captain G. H. Evans reported the case of a pony which contracted surra in a compound in Rangoon. The grass was obtained by its attendant from any source available, while the water supplied to the animal came from the municipal supply pipes. This was the first case of surra acquired in that city observed by the above officer during a residence of some 6 or 7 years."

Lingard's presentation of this case does not absolutely convince us that either water or grass conveys the disease. There is nothing at present known in connection with the biology of any *Trypanosoma* which would lead us to look seriously upon the grass and water as sources of infection with surra, notwithstanding the fact that this method of infection has been referred to by so many authors. Naturally, stagnant water will not improve the health of animals, but, on the contrary, will increase the infection with parasitic worms, and so tend to reduce the condition of the stock. Futhermore, insects will be present in greater numbers under the conditions described, hence these localities will naturally present a greater chance for the spread of the disease. Our remarks are not to be interpreted as a denial of the possibility of infection in the way described, but simply as an expression of reserve or perhaps skepticism upon this point, pending further investigations. Our skepticism finds decided support in the remarks by Pease (1897), quoted on page 125 of this report.

F.? INGESTION OF GRAIN SOILED WITH EXCREMENT OF THE RAT AND THE BANDICOOT.

In discussing the subject Lingard (1899, p. 76) says:

> "In 1891 experimental inoculation of equines proved that out of 12 animals inoculated with soiled rat's blood 4, or 33 per cent, contracted surra and died of a virulent form of the disease in an average of 7 days. The above experiments raised the question as to how rats could cause the disease in horses, for the food would rarely, if ever, be soiled with the blood of these small animals. It therefore only remained to be tried whether the excreta of rats, in whose blood the infusorian was present at the time of its collection, could cause the disease when mixed with grain. Experiments with this end in view were carried out, and one Australian horse contracted surra in 1893, the incubation period occupying some time between June and September, during which the animal received daily rat excrement mixed with its ration of corn. This was evidence that when a horse is made to ingest soiled material day by day surra may finally be contracted, but whether the disease was ever actually produced in the natural course of events by this means at that time, there was no testimony forthcoming. Inquiries were instituted in different parts of India in order to discover whether any folklore existed on the subject, and syces and keepers of horses were interrogated for a similar purpose. In June, 1895, one gentleman, with many years' experience in India, stated 'that it was a fixed idea in the minds of many natives in the Northwest Provinces and Oudh that if horses were allowed to eat corn soiled with rat excrement some of them would be more than likely to die within a few months.' Again, the following statement was made by an old syce: 'It is a common belief among syces that rat's dung in the corn given to horses makes them ill.' Further testimony with regard to small animals was obtained to this effect: 'Some years ago we lost a couple of goats, and the native who tended them said death was due to the rat's dung we found among the stock of gram the animals had been fed upon.'
>
> "From the above statement it will be gathered that animals can acquire the *Trypanosoma*, or organism of surra, by different means. The thousands of equines which have succumbed to that disease in the Punjab alone have to shift for themselves, and under no circumstances obtain anything as fodder but the grass they can find and water from the nearest source. Therefore the question of rat excrement can be at once excluded as a factor in the causation of the disease in that class of animals. But with regard to the question of surra being communicated by the bites of a fly, we know that when once the disease is started it may be reproduced to any extent by these insects. The evidence put forward with regard to the effect of rat excrement in corn is also of great importance to the horse owner in India."

We are inclined to accept Lingard's reasoning in this case with double reserve. While it appears that rats may contract horse surra, it has not been shown that *Trypanosoma* are found in the excrement either of horses or of rats, nor is it clear to us that during the experiment mentioned, extending over three to four months, the necessary precautions were taken to exclude fly bites and other factors. If, in fact, *Trypanosoma* accidentally reached the feces through intestinal hemorrhage, it is not clear how they could be infectious, for rat feces dry rapidly, and drying appears to kill this parasite, as has been proved also for other species of *Trypanosoma* (see p. 143). Finally, even if it is assumed that the rat trypanosomiasis found was identical with the horse surra, it is at least possible that it might have been transmitted by rat fleas perhaps as easily as by the ingestion of excrements.

SYMPTOMS OF SURRA.

GENERAL CLINICAL PICTURE.

Lingard (1893, pp. 62–64) has given the following summary of symptoms—the most complete summary which has as yet been published by any author whose papers we have been able to consult:

> "Before describing the symptoms of surra, it will be necessary first to divide cases of the disease under two different heads, viz: A. Those which have contracted the disease in the natural course of events; B. Those which have acquired the disease by inoculation.
>
> "*A. Symptoms of the disease as observed when contracted naturally.*—The invasion of this disease is usually marked by symptoms of a trivial character; the skin feels hot, and there may be more or less fever; there is also slight loss of appetite, and the animal appears dull and stumbles during action; thus early a symptom sometimes appears, which may be the first intimation received of the animal's indisposition, and which, as a guide to diagnosis, is of great importance; it is the presence of a general or localized urticarial eruption. If the blood be examined microscopically it may be found to present a normal appearance, but in the majority of cases a few small, rapidly moving organisms will be observed, giving to the blood, as it passes amongst the corpuscles, a peculiar vibrating movement, which if once observed will not readily be forgotten. If the hematozoon has not been discovered in the blood for some days, the before mentioned may be the only symptoms noticeable, and as a rule, when treated with febrifuges, the horse quickly improves in health and the appetite returns. This condition does not last for more than a few days, when the animal is again observed to present a dull and dejected appearance, and on examination well-marked symptoms are found; the skin is hot, the temperature more or less elevated, 38.7° to 40° C.; the pulse full and frequent, 56 to 64 beats per minute; the visible mucous membranes may appear clean, but the conjunctival membranes, especially those covering the membrana nictitans, are usually the seat of dark-red patches of ecchymosis, varying in size in different animals. There is more or less thirst and slight loss of appetite, the animal eating its corn and green grass, whilst leaving all or a portion of the dried grass with which it has been supplied. At the same time there are slight catarrhal symptoms present, including lachrymation and a little mucous discharge from the nostrils. Occasionally at this period of the disease the submaxillary glands may be found enlarged and perhaps somewhat tender on manipulation. One symptom is markedly absent, namely, the presence of rigors, or the objective signs of chilliness. In addition it will be noted that there is some swelling and edema of the extremities, generally between the fetlock and the hock, which pits but is not painful on pressure, and in the cases of horses there may be present also at this stage of the disease some swelling of the sheath. When the fever

and concomitant symptoms have declared themselves during a short period, one thing becomes especially noticeable in every animal attacked, namely, the rapidity with which it loses flesh. If the blood has been examined microscopically during the second period of fever, at first a few hematozoa will have been observed in it, which day by day increase in number and reach a maximum, where they remain for a varying period, or at once suddenly or gradually disappear during the period of apyrexia. After the fever and the accompanying symptoms have for the second time been present for some days, the period varying from one to six, the animal is found to have lost the dull, dejected appearance and to look bright. The elevated temperature has fallen and, in some cases, has attained normal or even subnormal limits. The visible mucous membranes are clean and the conjunctival petechiæ begin to fade; the pulse, however, will be found to be weak and thready in character, but the appetite excellent, and, in fact, if it were not for the loss of flesh and slight edema of the extremities, there would be little to show that the animal was ailing. But unfortunately this condition does not continue for any length of time, for again the temperature is elevated; in the course of a few hours the thermometer registers a still higher degree, the animal is dull and dejected, and by the following day the visible mucous membranes present a yellow tinge; large ecchymoses, dark in color, appear on the conjunctival membranes; the action of the heart is irritable, the pulse full and quick, or at times intermittent, and regurgitation may be observed in the jugulars; the breathing is quickened and the individual respirations shallow. On watching an animal in this condition it may be noticed that it takes seven to eight very short inspirations, and these are followed by a much more prolonged and sonorous one; at the same time the breathing is more abdominal than thoracic in character. On examination of the extremities it will be found that the swelling and edema have increased considerably, and that on the undersurface of the abdomen, where it was previously confined to the sheath, it has now commenced to spread forward along the subcutaneous tissue between the skin and the muscles. During the whole of this time the appetite will have varied little, and the evacuations will be only slightly, if at all, altered in character. In the blood a repetition of the previous events takes place, the hematozoa make their appearance and run up to a maximum, and again suddenly or gradually disappear according to the length of the fever period. These periods alternating with and without fever may go on for a considerable time. The progress of the disease is variable, and greatly depends upon the condition of the animal attacked, the weak ones succumbing very rapidly; but each bout of the fever brings with it, as a rule, an increase in the severity of the symptoms. There is augmented yellowness of the membranes, fresh crops of petechiæ on the conjunctiva, a collection of gelatinous material at the inner canthi, which at times becomes red in color from an admixture of blood, and which on microscopical examination is found to contain a varying number of the surra hematozoa; increased swelling and edema of the extremities and abdomen, which now extends between the fore limbs and up the chest. During this time the wasting has been steadily progressive, especially the muscles of the back and those surrounding the hip joint and the glutei.

"Toward the termination of the disease, it will be noticed that an animal is disinclined to move, and when made to do so there will be manifest loss of power over the hind quarters, somewhat simulating a slight partial paralysis, and the hind quarters of the animal reel from side to side. In connection with this it may be noted that there is frequently present paralysis of the sphincter ani and a dilated condition of the anus. These symptoms taken together point to some interference with the normal functions of the spinal cord in the lower dorsal and lumbar regions, and are probably due to pressure caused by an exudation within the spinal membranes. In many cases shortly before death the heart's action becomes exceedingly violent, shaking the whole frame at each beat, so that the sound can be heard at some distance from the animal. In some of these cases the animal may suddenly drop dead; in others the emaciation and weakness become so pronounced that the animal falls to the ground, and, after a short bout of struggling, succumbs to the disease. In other cases, again, the animal falls to the ground and appears to be suffering from acute pain, struggles violently, sweats bedew the body, and the respirations are very hurried. The struggles soon exhaust the patient's strength, and for a time it lies quiet; soon, however, the struggles commence again, and this continues until death occurs.

"*B. Those which have acquired the disease by inoculation.*—Twenty-four hours after the subcutaneous injection of a small quantity of surra blood, in the great majority of cases, a small, circumscribed, and somewhat raised swelling is noticed at the seat of inoculation. After 48 hours the tumor has increased in size, and is accompanied by some edema; it presents a certain amount of tension of the parts involved, and is generally tender on manipulation. These conditions continue to increase, until by the fourth day the tumor may measure 3 or 4 inches in one direction, by 2 or 3 in the other, and raised to the extent of an inch or an inch and a half above the surrounding tissues, or in some cases present an almost circular form throughout. It will be also found that, if the tumor be firmly grasped, it is not fixed, but can be lifted up from the subcutaneous tissue. According to the nature and amount of the inoculated blood so will these symptoms rapidly present themselves, and either attain a maximum or be retarded, until, varying from the fourth to the thirteenth day, the tumor at the seat of inoculation will be found to have lost a certain amount of its tension and tenderness. From this date the swelling and edema will gradually begin to grow less, until, finally, after a period of 10 to 14 days, the only sign left of the former swelling will be a slight thickening of the skin over the point of injection; but at the moment when the tension and tenderness of the parts at the seat of inoculation become suddenly decreased, a symptom of the utmost importance clinically takes place, viz, at that moment the organism of surra enters the blood of the general circulation.

"The temperature on the day of inoculation, and in fact for several days afterwards, may remain normal in character, there being only a few points difference between the morning and evening observations. In other cases there may be a slight rise from the first evening, and a gradual progressive rise until the swelling at the seat of inoculation shows signs of reduction in size, when the temperature generally takes a decided rise again, and may attain 40° or 41° C. This elevation will last a varying period of from 2 to 6 days, and on the day following its onset the ordinary symptoms of fever will be noticed; and in addition there will be petechiæ on the conjunctival membranes, lachrymation, a slight mucous discharge from the nose, and in severe cases some oedema of the lower portion of the extremities, and perhaps of the sheath in horses. At the termination of the period of fever, the temperature will be found to have fallen to normal or nearly so; the animal will present a brighter aspect, and there is every appearance of its return to health; but in a few days the animal again appears dull and semisomnolent; the temperature becomes elevated, and a relapse takes place, and a repetition of all the symptoms in the primary paroxysm, including the reappearance of the hematozoon, is observed."

Griffith Evans (1881, p. 2) states that the symptoms of surra should be divided into (1) those common to other maladies, and (2) those characteristic of this disease. Invasion of surra, acquired in the ordinary way, is that common to all low fevers.

Surra in camels.—According to Hagger (see Lingard, 1899, p. 35), the most prominent symptoms in the camel, in addition to the fever, are swellings which appear on the sides of the chest near the pad and in the sheath and scrotum of males and in the udder of females. These swellings form into large abscesses containing an enormous quantity of thick cream-colored pus. From the first to the last there is progressive anemia, and, although the appetite generally remains good, the animal rapidly wastes away until it becomes a mere living skeleton. The parasite is not present in the blood continuously during the whole course of the disease. The periods during which it is present are marked by elevation of the body temperature (fever), which rises in some cases to 106° F. and sinks to the normal during the intermission, when the parasites are absent. The disease is invariably fatal in the horse, but the camel men aver that a small percentage of camels, which can tolerate it for three years, recover.

Surra in cattle.—According to Lingard (1899, pp. 80–88), surra will undoubtedly develop in bovines and buffaloes, but these animals do not appear especially susceptible to the disease; they may, in fact, recover from the attack, put on flesh, and appear in robust health.

Surra in wild animals.—We have scarcely any information at present in regard to surra in wild animals, but it seems very probable that some wild animal will be found which suffers from the disease in but a slight degree and which therefore will be able to keep up the infection of a district from year to year. Curry (1902) has recently reported surra in the Philippine "caribao" [kerabau, *Bubalis kerabau*].

ANALYSIS OF SYMPTOMS.

ONSET AND INCUBATION.

There is no history of a definite *onset* (Burke, 1891, p. 268; 1897, p. 191), and the condition is progressive, usually with a number of relapses. According to the Veterinary Journal, London (1896, p. 177), there is rarely an opportunity to note early symptoms, the attack usually being a mild one, with the animal a little dull and off its feed, but after a few days' rest, it apparently recovers, and the owner sends it back to work. The attack is somewhat of a bilious fever type, the animal being dull, listless, and leg-weary.

The *period of incubation* is apparently subject to considerable variation. It is 6 to 8 days (2 to 7 days, Steel, 1886a, p. 255) in experimental cases caused by inoculation with or ingestion of blood taken from animals affected with surra; if the blood is from a dead animal, the incubation may be prolonged to 13 days; in cases where the blood has been diluted with water, and been given by mouth, symptoms may not appear for even 75 days. (Hayes, 1898, p. 481.)

According to Lingard (1893, pp. 55–58), the period of incubation varies according to circumstances:

"(*g*) *The latent period of surra*, or, in other words, the time which elapses between the introduction of the *materies morbi* into the system and the first appearance of the hematozoon in the blood of the general circulation, will be found to vary considerably according to certain circumstances. The chief conditions which influence it will be found under the following headings:

"I. The species of animal inoculated.

"II. The means used for inoculating the animal.

"III. The kind of fluid used for inoculation, viz: (*a*) blood; (*b*) serum; (*c*) fluid taken from the tunica vaginalis testis; (*d*) fluid taken from the pericardial sac; (*e*) cerebro-spinal fluid.

"IV. Whether the fluid used for inoculation was drawn ante- or postmortem from the animal affected with surra:

"(*a*) *Antemortem.*

"(*i*) If during a paroxysm, the number of hematozoon present at the time of inoculation.

"(*ii*) If during an intermission or an apyrexial period, the presence or absence of anything on microscopical examination.

"(*b*) *Postmortem.*

"(*i*) The number of hours that were allowed to elapse between death and the inoculation.

"(*ii*) The number of hematozoa in the blood just previous to death.

"V. The quantity of the fluid introduced into the system of the animal, either by—

"(*i*) Direct injection into the general circulation.

"(*ii*) Gastric ingestion.

"(*iii*) By subcutaneous inoculation.

"(*iv*) By smearing on an abraded surface or slight cutaneous incision from which no blood escaped.

"(I.) THE LATENT PERIOD IN NATURALLY CONTRACTED CASES.

"A most difficult point to clear up, and one which up to the present has not been recorded, is the latent period of surra in cases in which it is contracted naturally. The difficulty can more readily be understood when it is recognized that the contagium is, in all probability, taken into the system of the animal, together with its forage or water, or perhaps with both; and that at a subsequent period, when the symptoms of disease become evident, the animal may be in a different part of the country altogether.

* * * * * * *

"(II.) THE LATENT PERIOD, WHEN THE CONTAGIUM IS GIVEN BY THE MOUTH.

"(*a*) Gastric ingestion of a considerable amount of soiled blood.

"(*b*) In small doses in water, following more closely the way in which animals are supposed to contract the disease naturally.

"(*a*) *By gastric ingestion of a considerable amount of soiled blood.*—On the evening of September 29, 1880, Evans experimented upon a fairly healthy aged mare by administering 20 ounces of blood drawn from the jugular vein of an animal suffering from surra. On the morning of October 6, the blood when examined microscopically was swarming with very active parasites. In this case an observation was made on the 4th of October, to the effect that the temperature was 99.8° F. (37.6° C.); blood examined, but no parasite found; but there is no note on the following day, the 5th, regarding the condition of the blood, although the temperature is recorded as having been 102.2° F. (39° C.). Consequently I am inclined to believe that the hematozoon would have been found on the 5th if it had been looked for, taking into account the rise of temperature and the fact that the hematozoa were swarming in the blood on the morning of the 6th. In this case, then, the latent period may be said to have been only 5.5, or at the most 6.5 days.

"On the morning of the 30th of September, to a second mare Evans gave 20 ounces of blood, drawn from the jugular vein of the same horse as that from which the blood was taken for the preceding experiment. On the morning of the 6th of October, with a temperature of 103° F. (39.4° C.), the blood presented many parasites, but not swarming as in the last case. The latent period extended from the morning of the 30th of September to that of the 6th of October, or 6 days.

"(*b*) *By giving small repeated quantities of soiled blood in water.*—As no previous researches have been conducted with small quantities of soiled blood in water, it was decided to endeavor to produce the disease in a somewhat similar manner to that in which it is naturally contracted. With this end in view, a strong healthy Australian gelding was obtained, sixteen years old and in good condition, to which small quantities of blood mixed with a large bulk of water were to be given at short intervals. Accordingly on the 4th of May, 1891, 4 minims (0.25 c. c.) of blood (swarming with the surra hematozoon) mixed with 1 gallon of fresh water, were given to the animal to drink. Up to the 9th no change had taken place in the animal's condition, and on this date 8 minims (0.53 c. c.) of blood containing numerous hematozoa were given in the same way. On the 10th and 11th the animal showed no change. On the latter date 6 minims (0.4 c. c.) of blood containing the surra hematozoon were given in a quart of water. On the 12th a few small petechiæ were noticed on the membranæ nictitantes. Up to the 24th, with the exception of a slight indisposition on the 18th, which rapidly passed off, no symptoms of disease were noticed. On the 24th the animal received in water 8 minims (0.53 c. c.) of blood containing very numerous hematozoa; no change of any importance was noticed up to the 6th of June, and on that date the animal received in water 8 minims of blood containing numerous hematozoa. There was no change on the 14th of June, when 30 minims (2 c. c.) of blood containing very numerous hematozoa were given in 3 quarts of water. On the 16th no change having taken place, 10 minims (0.66 c. c.) of blood swarming with hematozoa were given. On the 17th 25 minims (1.6 c. c.), taken from horse No. 23 suffering from surra, but from which the hematozoon was absent, were given in a gallon of water. From this date to the 28th of June no change was noticed. On the latter date 200 minims (13.3 c. c.) of blood containing very numerous hematozoa were administered in a bucketful of water. From this date (June 28) up to September 1 absolutely no symptom of disease was noticed; but from the 1st until the 6th of September there was a very slight disturbance of temperature, which, however, remained normal. On the morning of the 11th of September the temperature had risen to 39.4° C. and numerous hematozoa were observed in the blood.

"Thus it will be seen that from the first exhibition to the animal of the soiled surra blood on May 4, 1891, until the last on the 28th of June, a period of 55 days had elapsed; and from the exhibition of the last 200 minims, until the first appearance of the hematozoon in the blood, 75 days; or from first to last, 130 days.

"(III.) THE LATENT PERIOD WHEN THE FLUID USED FOR INOCULATION IS DRAWN ANTE- OR POSTMORTEM FROM THE ANIMAL AFFECTED WITH SURRA.

"*Antemortem.*

I. *Blood taken during a paroxysm*—

(*a*) *By gastric ingestion.*—Horse No. 20: 200 minims containing very numerous hematozoa. Period of incubation from the date of the last administration, 75 days.

(*b*) *By direct injection into the general circulation.*—Horse No. 15: 0.8 c. c. containing numerous hematozoa, 6 days. Horse No. 14: 0.7 c. c. containing numerous hematozoa, 5 days.

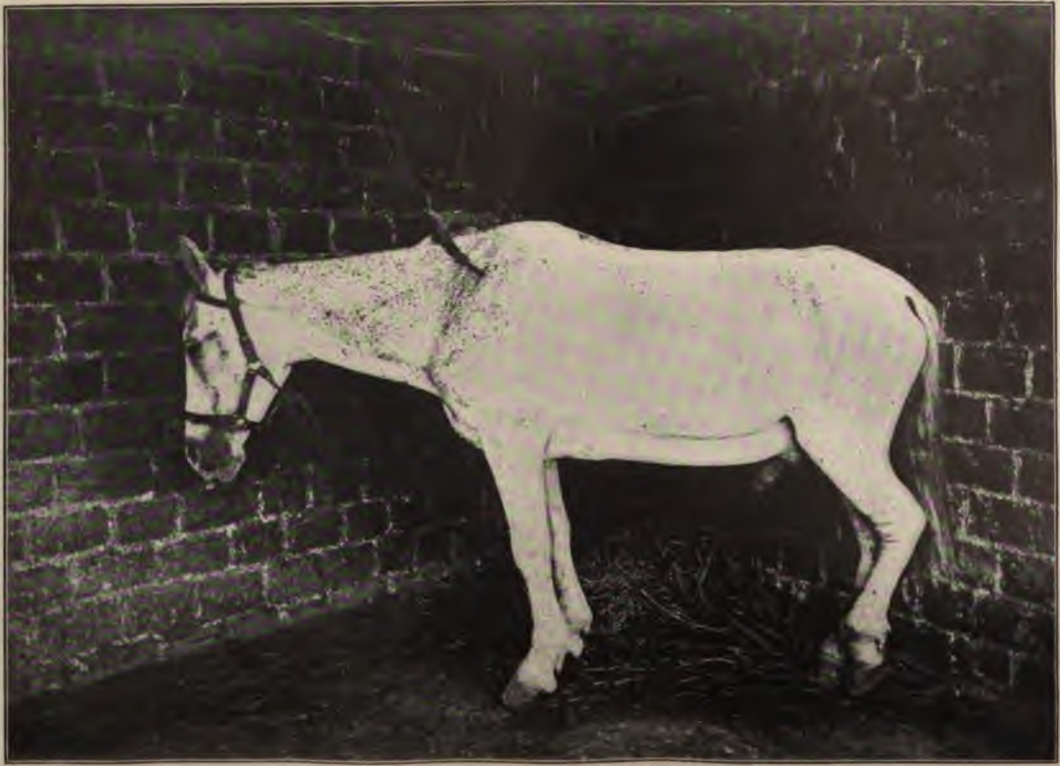

FIG. 84.—HORSE NO. 21 SHOWING THE SWOLLEN AND EDEMATOUS CONDITION OF THE EXTREMITIES, SHEATH, AND UNDERSURFACE OF THE ABDOMEN ON THE NINETEENTH DAY OF THE DISEASE.

(After Lingard, 1893; p. CL.)

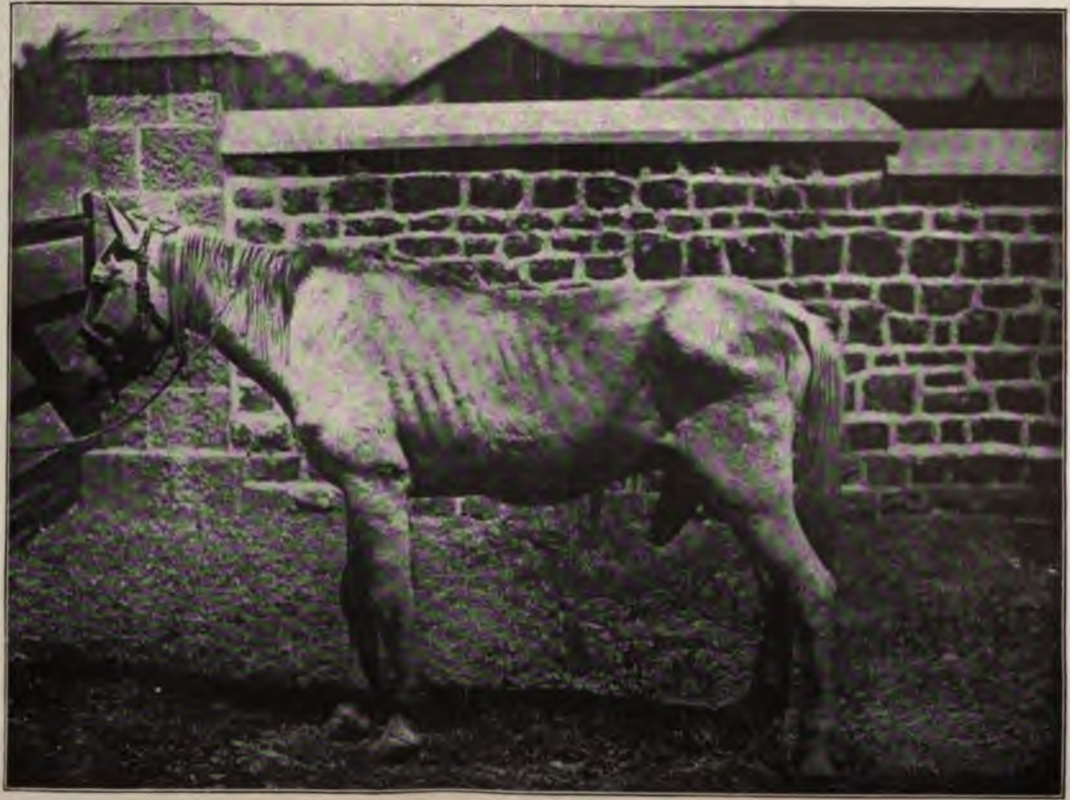

FIG. 85.—HORSE NO. 55, SHOWING CONDITION ON TWENTY-SECOND DAY.

(After Lingard, 1893; p. CLXVIII.)

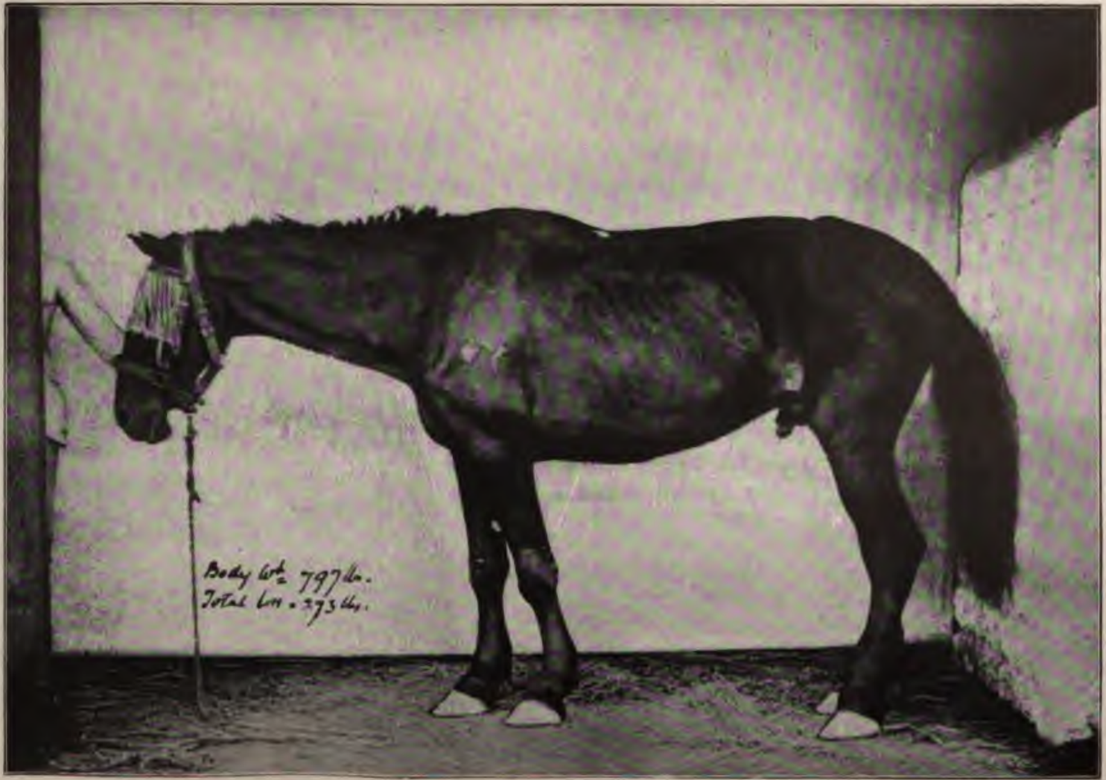

FIG. 86.—HORSE NO. 89, SHOWING CONDITION ON FIFTIETH DAY OF THE DISEASE.

(After Lingard, 1899; Pl. I.)

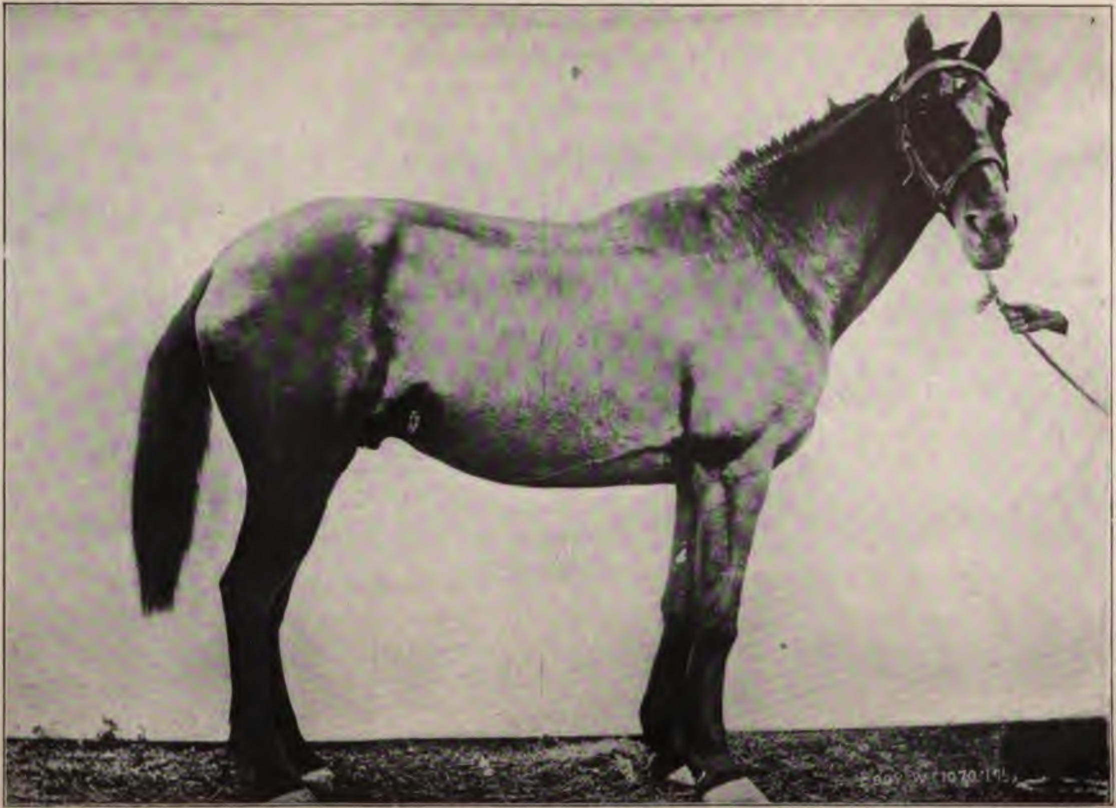

FIG. 87.—HORSE NO. 89, AFTER SUCCESSFUL TREATMENT.

(After Lingard, 1899: Pl. II.)

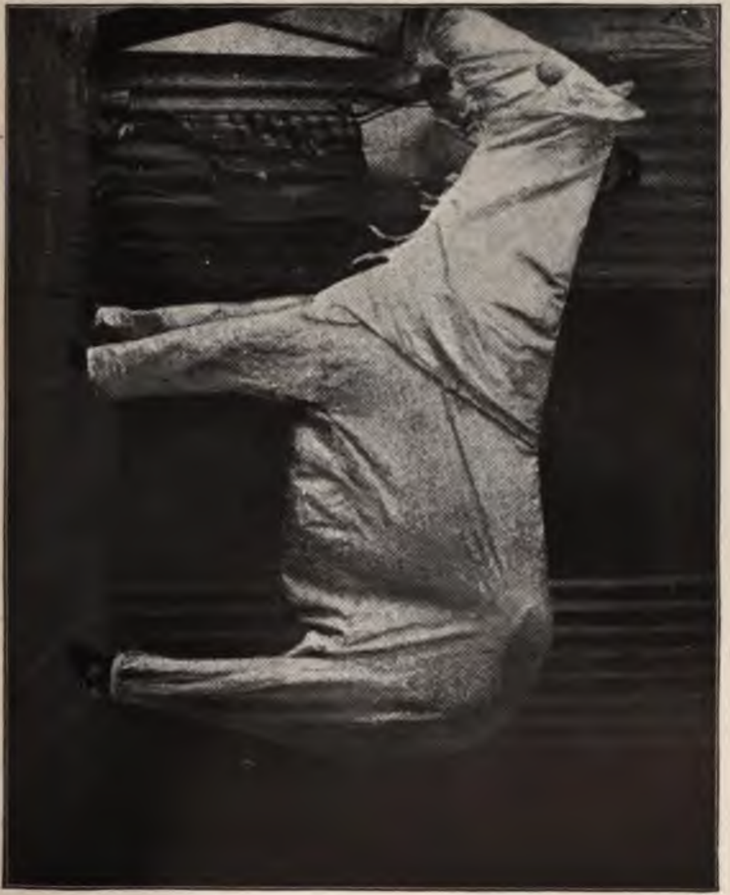

FIG. 88.—PONY IN PAJAMAS, AS A PROTECTION AGAINST THE TSETSE FLY.

(Negative by Lieut. T. C. Johnson, A. S. C. Copied from Stordy, 1899; p. 14.)

(*c*) *By subcutaneous injection.*—Horse No. 5: 3 c. c. containing very numerous hematozoa, 4 days. Horse No. 8: 1 c. c. containing very numerous hematozoa, 5 days. Horse No. 22: 1 c. c. containing very numerous hematozoa, 4 days. Horse No. 4: 1 c. c. containing few hematozoa, 8 days. Horse No. 30: 1 c. c. containing few hematozoa, 7 days. Horse No. 29: 0.8 c. c. containing few hematozoa, 7 days. Horse No. 59: 0.5 c. c. containing numerous hematozoa, 5 days. Horse No. 64: 0.5 c. c. containing few hematozoa, 7 days. Horse No. 12: 0.13 c. c. (2 minims) numerous hematozoa, 6 days. Horse No. 54: 0.1 c. c. containing swarms of hematozoa, 4 days. Horse No. 55: 0.1 c. c. containing swarms of hematozoa, 7 days. Horse No. 24: a fraction of 1 minim, very numerous hematozoa, 7 days.

II. *Blood taken during an intermission*—

(*a*) *By subcutaneous injection.*—Horse No. 13: 1 c. c. hematozoon absent from the blood, 8 days. Horse No. 21: 1 c. c. hematozoon absent from the blood, 8 days. Horse No. 48: 0.5 c. c. hematozoon absent from the blood, 10 days.

"*Postmortem.*

I. *Blood removed from the heart or great vessels*—

(*a*) *By subcutaneous injection.*—Horse No. 27 inoculated with 2 c. c. blood taken 16 hours postmortem, from which the hematozoon was absent, but very numerous antemortem. Latent period 11 days. Horse No. 11 inoculated with 1 c. c. blood taken 10½ hours postmortem, from which the hematozoon was absent, but very numerous antemortem. Latent period 11 days. Horse No. 18 inoculated with 2 c. c. blood taken 10 hours postmortem, from which the hematozoon was absent, but numerous antemortem. Latent period 13 days. Horse No. 19 inoculated with 2 c. c. blood taken 10 hours postmortem, from which the hematozoon was absent, but numerous antemortem. Latent period 9 days. Horse No. 32 inoculated with 0.3 c. c. blood taken 8½ hours postmortem, from which the hematozoon was absent, but very numerous antemortem. Latent period 9 days. Horse No. 46 inoculated with 1 c. c. blood taken 8¼ hours postmortem, from which the hematozoon was absent, but very numerous antemortem. Latent period 8 days. Horse No. 23 inoculated with 1 c. c. blood taken 5½ hours postmortem, from which the hematozoon was absent, but swarming antemortem. Latent period 8 days. Horse No. 58 inoculated with 1 c. c. blood taken 5 hours postmortem, from which the hematozoon was absent, but swarming antemortem. Latent period 9 days.

II. *Blood serum from the large vessels*—

(*a*) *By subcutaneous injection.*—Horse No. 7 inoculated with 1 c. c. serum taken 2 hours postmortem, the hematozoon was absent, but was numerous in the blood antemortem. Latent period 8 days.

"*Antemortem.*

Tunica vaginalis testis fluid and blood.—Horse No. 33 inoculated with 1 c. c. of fluid from the tunica vaginalis testis of goat, in which the hematozoa were numerous. Latent period 5 days. Horse No. 34 inoculated with 1 c. c. of blood from No. 33, antemortem containing numerous hematozoa. Latent period 13 days.

"*Postmortem.*

I. *Blood removed from the heart or great vessels.*—Horse No. 38 inoculated with 1 c. c. of blood taken 9½ hours postmortem, from which the hematozoon was absent, but very numerous antemortem. Latent period 9 days. Horse No. 41 inoculated with 1 c. c. of blood taken 9½ hours postmortem from case No. 40, from which the hematozoon was absent, but very numerous antemortem. Latent period 7 days. Horse No. 40 inoculated with 0.6 c. c. of blood taken 1¼ hours postmortem from case No. 34, from which the hematozoon was absent, but very numerous antemortem. Latent period 6 days. Horse No. 31 inoculated with 0.3 c. c. of blood taken 8 hours postmortem from case No. 33, from which the hematozoon was absent, but swarming antemortem. Latent period 9 days.

II. *Blood serum removed from the large vessels.*—Horse No. 50 inoculated with 2 c. c. of blood serum taken 45 minutes postmortem from case No. 38, from which the hematozoon was absent, but swarming antemortem. Latent period 9 days.

"INOCULATION OF OTHER ANIMALS THAN HORSES.

"*Antemortem.*

I. *Blood taken during a paroxysm from horses*—

(*a*) *By subcutaneous injection.* Bull: 1.7 c. c. containing very numerous hematozoa. Latent period 7 days. Sheep: 0.8 c. c. containing a few hematozoa, and with 1 c. c. containing a few hematozoa 14 days later, no organism found in the blood, but they were found on the fifty-ninth day in the fluid of the tunica vaginalis testis. Goat: 0.5 c. c. containing swarms of hematozoa. Latent period was 7 days. Rabbits: 0.3 c. c. containing very numerous hematozoa, latent period 5 days; 0.3 c. c. containing very numerous hematozoa, latent period 9 days. Guinea pigs: 1 c. c. containing very numerous hematozoa, latent period 12 days. Guinea pigs: 1 c. c. containing very numerous hematozoa, latent period 9 days. Guinea pigs: 0.5 c. c. containing very numerous hematozoa. This was a pregnant doe, and the latent period was 7 days, showing that pregnancy predisposes. Rats (*Mus decumanus*): 0.2 c. c. containing very numerous hematozoa. Latent period, 1 day. Rats (*Mus decumanus*): 0.1 c. c. containing a few hematozoa. Latent period, 2 days. Rats (*Mus decumanus*): 0.1 c. c. containing a few hematozoa. Latent period 2 days. Rats (*Nesokia providens*): 0.2 c. c. containing numerous hematozoa. Latent period, 2 days. Rats (*Nesokia providens*): 0.2 c. c. containing numerous hematozoa. Latent period, 5 days. Rats (*Nesokia providens*): 0.2 c. c. containing numerous hematozoa. Latent period, 5 days.

"*Postmortem.*

I. *Blood and other fluids removed from the body*—

(*a*) *By subcutaneous inoculation.* Goat No. 3 inoculated with 1 c. c. blood taken 5¼ hours postmortem, from which the hematozoon was absent, but swarming antemortem. Latent period, 6 days. Guinea pig inoculated with 0.4 c. c. cerebrospinal fluid 2 hours postmortem, hematozoa absent, but very numerous in the blood antemortem. Latent period, 11 days. Guinea pig inoculated with 1 c. c. pericardial fluid 13 hours postmortem, hematozoa absent, but swarming in the blood antemortem. Latent period, 10 days. Guinea pig inoculated with 1 c. c. pericardial fluid 13 hours postmortem, hematozoa absent, but swarming in the blood antemortem. Latent period, 10 days." (Lingard, 1893, pp. 55–61.)

STAGES AND DURATION.

The duration of surra varies with the species of animals attacked, their age and general condition, but sex has no influence. According to Griffith Evans (1881, p. 4), the records of the Fourth Punjab Cavalry show an average duration of 43 days after admission on the sick list. Burke (1888a, p. 9; 1891, p. 268) gives the average (taken from Evans) as probably not less than 2 months. According to Burke (1897, p. 192), naturally weak animals succumb more quickly than strong ones; in some cases the course is very rapid, and may be (1891, p. 268; 1892, p. 192) less than 1 to 2 weeks. Nariman & Vaz (1893, p. 403) describe the animals as dying by inches. The Veterinary Journal, London (1896, p. 179), gives the duration as proportionate to the animal's age, constitution, and condition; young horses may pass through seven or nine paroxysms, while old, worn-out animals may succumb quickly. Pease (1897, p. 560) states that nearly all cases take a month or more to kill, and Hayes (1898, p. 481) quotes Gunn as authority for 52 days as the average duration.

In discussing the subject of stages and duration, Lingard (1893, p. 73) says:

> "*Stages.*—The fever of surra, as before mentioned, varies to such an extent in different cases that it is impossible to group any number of them under any one system of description as regards the stages of the disease. The insidious nature of the onset in the naturally contracted disease, devoid of symptoms during a considerable period, renders it impossible to recognize it until such time as the organism appears in the blood. Consequently little is known concerning the latent period and stage of invasion, and in such cases, when untreated, the fever is of a continued type, followed by one or more intermissions at long but irregular intervals.
>
> "In this disease, when artificially produced, the majority follow the type before mentioned, but a number present a peculiar series of symptoms, reminding one of relapsing fever in man. But here again certain variations are observed. Such cases as Nos. 20, 38, 50, 54, however, lend themselves to description, which will be made clear on reference to the charts, and may be described as presenting well-marked stages, viz:
>
> "I. The period of incubation, or latent period.
> "II. The primary paroxysm.
> "III. The intermission.
> "IV. The relapse.
> "V. Death.
>
> "The paroxysms, as in relapsing fever in man, are again subdivisible into the accession, the pyrexial stage, and the crisis. But in all cases of surra we find periods during which the hematozoon is present, and others during which it is absent. The only system, therefore, under which all cases can be grouped is that having for its basis the presence and absence of the organism; the former we term the paroxysm and the latter the period of intermission."

THE COAT.

The coat of affected animals is described as staring. (Griffith Evans, 1881, p. 2.)

PERSPIRATION.

This symptom is entirely absent during the whole course of the disease, until just before death, when, as a rule, profuse sweating occurs. (Lingard, 1893, p. 68.)

ERUPTION, URTICARIA, EDEMA.

Referring to eruption and edema, Lingard (1893, p. 64) says:

"*Eruption.*—In the majority of cases, no eruption of any kind occurs during the whole duration of the disease. Steel, however, noted in mules an eruption of spots on the skin of the muzzle, resembling in its essential nature those he had observed on the mouth and nostrils. In the course of this investigation we have observed a number of cases of urticaria, appearing somewhat suddenly and, as a rule, disappearing after a few hours. The eruption has been either general or localized in character, and could be conveniently placed under several of the different classifications, viz: The affection which passes away in a few hours (*Urticaria ephemera*), or within a few days (*U. evanida*), or the form which is either preceded or accompanied by fever (*U. febrilis*), and lastly the (*U. nodosa seu tuberosa*), which is characterized by the appearance of nodosities of some size.

"If we further examine as to the dates on which the eruption occurred in the different cases, we find that in the naturally contracted ones (horses Nos. 65 and 73) it occurred on the first day of the disease, and was of the form known as *Urticaria evanida;* in horse No. 71 it appeared on the sixteenth day, and was an *Urticaria ephemera;* that in horse No. 3, on the eighteenth day was an *U. ephemera* also; and in horse No. 72, on the twenty-second day, *U. evanida;* in horse No. 20, which acquired the disease by gastric indigestion, it appeared on the ninth day of the disease, and was an *U. ephemera;* in the horses Nos. 22 and 6, it appeared in the former on the eleventh and in the latter on the twelfth day of the disease, both *U. ephemera.* And in the animals inoculated with the blood of the horses through the goat: In No. 41 the eruption appeared in 18 hours after inoculation (*U. evanida*), in No. 40 the eruption appeared in 68 hours after inoculation (*U. evanida*), in No. 30 the eruption appeared in 48 hours after the appearance of the hematozoon in the blood (*U. ephemera*), in No. 50 the eruption appeared in 48 hours after the appearance of the hematozoon in the blood (*U. ephemera*)." (Lingard, 1893, p. 66.)

Consequently it will be seen that the eruption of urticaria may take place at any time from 18 hours after inoculation until the twenty-second day after the appearance of the hematozoon in the blood.

"*Swelling and edema at the seat of inoculation in experimental cases.*—When an animal has been subcutaneously inoculated with the soiled blood or other fluids containing the 'materies morbi' of 'surra,' considerable swelling, as a general rule, follows at the seat of such injection. If we analyze this symptom we find that on the day following the operation a small raised, somewhat circular tumor appears, about 1 inch in diameter, while in some cases, especially when the blood used was obtained some hours postmortem, the measurements greatly exceed this, as in cases 27 and 41. On the third day the swelling has increased in dimensions, and probably measures from 1½ to 2 inches in diameter; it now appears tense, and is tender on manipulation. By the fourth day a still further augmentation in size, etc., has occurred, and from this date until the appearance of the hematozoon in the blood of the general circulation, the swelling, tension, and tenderness of the part may go on steadily increasing, or, as sometimes happens, it remains stationary. At this time it will be found, that if the tumor be firmly grasped by the hand, one can readily lift it up from the subcutaneous structure, proving that it only involves the skin. A point of great interest and a symptom of the greatest clinical value occurs at the time of the organism leaving the seat of the swelling—for the hematozoon has been proved, as in horse No. 8, to be present in the fluid of the tumor 3 days after inoculation, and 2 days before being discovered in the blood of the general circulation; and, in the case of horse No. 54, 24 hours before its first appearance in the blood—in that the raised tumor, which was previously tense and so tender that the animal flinched whenever touched, now suddenly becomes soft and flaccid, and manipulation of the parts can be carried on with little or no notice being taken by the inoculated animal.

"It will, therefore, be recognized that from the time of inoculation until the organism leaves the tumor for the general circulation, or, in other words, during the latent period of inoculation, this disease is purely a localized affection, and can therefore be treated either by excision or by the injection of antiseptics at the seat of inoculation.

"In 1 case only out of 22, which contracted the disease by experimental means, was the swelling absent from the seat of inoculation, but in this from first to last, during a period of 9 days, no swelling or thickening of the integument could be felt. The shortest time noted in horses during which the swelling attained its maximum, and commenced to decrease in size was 96 hours, and the longest 12 days, the average length of 21 cases being 6.7 days. Within a very few days after the appearance of the hematozoon in the blood, the tumor has usually decreased considerably in size, and after a fortnight only a slight thickening of the skin can be noticed on careful examination of the part." (Lingard, 1893, pp. 66–67.)

According to the Veterinary Journal, London (1896, p. 177), with the rise in temperature there is usually an attack of local or general urticaria. There is generally some edema of the limbs, about the fetlocks and hocks, and beneath the belly, chest, and sheath.

In a large proportion of the cases the legs are swollen, and when pressed with the fingers they pit. Sooner or later a similar swelling is found between the fore legs of mares or at the sheath of horses, and the animal is dropsical (Griffith Evans, 1881, p. 3); (p. 4) the progress is variable, often marked by an increase of dropsical swelling which, however, sometimes subsides, again returning worse than before. Evans has seen some cases, in the last stage, in which there was no swelling, although it had been there before.

Nariman & Vaz (1893, p. 404) refer to an edema of an evanescent nature on the hind limbs, beginning at the fetlock and extending upward; edema of the sheath and testicles extending slightly to the lower part of the abdomen; later it becomes more prominent on the hind limbs and is often seen on the fore limbs, while the edema of the abdomen extends to the chest and breast.

Dropsy is frequent (Steel, 1886a, p. 169).

SWELLING OF THE SUBMAXILLARY GLANDS.

The submaxillary glands sometimes become enlarged. Griffith Evans (1881, p. 3) says that in a small proportion of the cases the submaxillary glands are enlarged and tender; in a few cases (Griffith

Evans, 1881, p. 4) the swelling of the submaxillary glands develops into an abscess, with a gluey mucous discharge from the nose. No other swellings are noticed and no ulceration of the nose nor tubercle of the lungs.

EMACIATION.

According to Griffith Evans (1881, p. 4), the most constant and invariable symptom in the progress of the disease is the wasting away of the flesh; and this appears the more remarkable, considering how much the patient eats and apparently with good appetite. This wasting, or withering away, goes on more rapidly in some cases than in others. Several authors refer to the patients as consisting only of skin and bones and as presenting a most pitiful appearance.

Lingard (1893, p. 80) says that the body is usually much emaciated, the word "surra" implying "rot" or "dry rot;" and the disease is characterized by a progressive loss of flesh, or withering of the tissues. In some cases, however, when the animal is carried off rapidly, owing to the severity of the fever or from other causes, it may be in fairly good condition.

EYES.

Lachrymation.—This at first is slight, but in some animals rapidly increases in amount until it becomes profuse. At a varying period in the disease there appears at the inner canthus a semigelatinous secretion, which may become mucopurulent in character, and during the presence of the hematozoon in large numbers in the blood, slight hemorrhages take place from the conjunctival membranes, and the secretion becomes blood-stained. At these times it always contains the hematozoon in varying numbers. (Lingard, 1893, p. 72.)

Griffith Evans (1881, p. 3) remarks that the eyes are "weeping," while the Veterinary Journal, London (1896, p. 177), states that the eyelids are swollen, and perhaps conjunctivitis may be present. Lachrymation may be profuse toward the end of the disease.

Petechiæ.—If the eyelids are inverted (Griffith Evans, 1881, p. 3) the conjunctival membrane is seen to be of a decidedly yellow color, often a dirty yellow, with claret-colored spots (petechiæ) on the eyelids, or, as is most common, on the membrana nictitans at the inner corner of the eye. According to Steel (1886a, p. 169), a characteristic feature of the disease, and one which seems to be in direct and close relations with the activity of the parasites in the blood, is the occurrence of "crops" of petechiæ, especially detectable on the conjunctivæ; they seem to occur when the parasites have attained their maximum activity and frequency, and when the temperature begins to fall.

This is not the only disease in which petechiæ or more extensive extravasations occur, for these are usually present in anthrax, so-called bilious fever, petechial fever, and other diseases; also when an animal is suffering from the presence of small nematodes in the general circulation. In surra the petechiæ on the conjunctival membranes are specially prone to invade the membrana nictitans of the Equidæ, and frequently attain a large size, becoming relatively extensive extravasations. They may precede the discovery of the hematozoon, but, as a rule, are found shortly after the first appearance of the organism in the blood, and commence to fade immediately when it disappears; and, as each successive brood of the hematozoon makes its debut, a fresh crop of petechiæ appears on the membranes, and it often happens that a second series of petechiæ is present before the first has completely faded. (Lingard, 1893, p. 72.)

Later, Lingard (1899, p. 26) says that the conjunctivæ are frequently stained with yellow, and there are successive crops of subconjunctival petechiæ.

Hemorrhages into the anterior chamber occasionally occur, but the amount of blood is generally small. The color at first is red, and after a period of 24 hours or more the coloring matter is absorbed, leaving the extravasated mass either of a whitish hue or somewhat yellow in the case of an animal in which the membranes are already tinged that color. As a rule, no absorption of the extravasated material takes place, owing to the short period which elapses between the occurrence of it and death. (Lingard, 1893, p. 72.)

The Veterinary Journal, London (1896, p. 177), also records that slight hemorrhages occasionally take place into the anterior chamber of the eye, followed by opacity.

Opacity of the cornea.—Complete opacity is of rare occurrence, but toward the termination of a long case a slight milkiness of the cornea may be observed, and is not at all infrequent. Lingard has, however, seen one case in an Arabian horse, where complete opacity occurred a few days before death, and therefore blindness supervened. (Lingard, 1893, p. 72.)

Hematozoa.—On several occasions *Trypanosoma* have been observed in the fluid of the anterior chamber and in the vitreous humor. (Lingard, 1893, p. 72.)

NOSE.

Catarrhal discharge.—There are slight catarrhal symptoms, the eyes weeping; and often there is a discharge from the nose of mucus more or less tinged with yellow (Griffith Evans, 1881, p. 3). In later stages there may be gelatinous or purulent discharge from the eyes and at times from the nostrils, with fullness and enlargement of the submaxillary glands. According to Lingard (1893, p. 73), there is often a slight discharge of clear fluid from one or both nostrils during the second week after invasion. This is the result of excessive lachrymation, which appears to a greater or less extent in all surra animals. The fluid passes down the lachrymal duct into the nostrils, and at a later date a clear albuminous fluid is noticed running from one or both of the latter. This comes from the nasal passages proper, and is the result of an inflammatory condition of the membrane covering the turbinated bones. This fluid after a time becomes mucopurulent in character, and another symptom is to be noticed, namely, snuffling-breathing, which points to the situation and cause of the discharge. If one could examine at this stage the mucous membrane covering the turbinated bones, it would be found to present a deep-red or purple color, from the highly congested condition of the capillary vessels, and to be considerably increased in thickness. The Veterinary Journal, London (1896, pp. 177–178), also refers to signs of catarrh, with a yellow-tinged discharge from the nostrils. Lingard (1899, p. 29) again refers to slight mucous discharge from the nostrils and eyes.

Petechiæ and injection of the nasal septum.—The presence of minute petechiæ on the walls of the *septum nasi* is of very constant occurrence. The mucous membrane covering the cartilage is tumefied, and presents small red points from which minute drops of blood exude. These points appear as if they might have been produced by punctures of a large number of needles, so minute are they. This condition does not show itself until the animal has been ill for some days, and then it might be easily overlooked without a certain amount of care in observation. (Lingard, 1893, p. 72.)

Ulceration inside the nostrils.—One observer (Steel) mentions the occasional occurrence in mules of ulcers on the Schneiderian membrane, when the epithelial débris remains as a yellow scab for a day or two and is then washed away by mucus. The earliest appearance of these ulcers in the nose is as though the membrane had been grazed and blood were slowly oozing. These ulcers rapidly disappear and the general character of the membrane becomes normal. Lingard has not observed these, however, in the cases of naturally acquired surra or in the inoculated cases. (Lingard, 1893, p. 72.)

The Veterinary Journal, London (1896, p. 177), also mentions that ulcers occasionally form on the Schneiderian membrane.

Thickening of the Schneiderian membrane.—This condition is frequently met, more especially at an advanced stage of the disease. By the entrance of air into the nasal passages and by its exit therefrom, a peculiar sound is produced, which is due to the swollen condition of the mucous membrane lining the cavities. On examination, a congested and arborescent condition of the vessels is found, particularly well marked on the upper part of the nasal septum. (Lingard, 1893, pp. 72–73.)

Epistaxis.—Lingard (1893, p. 73) observed bleeding from the nose once out of some 72 cases of surra. It occurred toward the termination of the disease. No great amount of blood was lost at one time, but the attacks were characteristically recurrent, occurring principally during the early morning.

MOUTH AND TONGUE.

When the disease has fairly set in, the tongue and membranes of the mouth become extremely pale, and later assume a yellow tinge. Some observers have noticed small symmetrically arranged ulcers in pairs on the tip of the tongue, and sometimes a degeneration of the epithelium, which at a later date separates from the deeper part of the membrane, leaving superficial circumscribed ulcers. (Lingard, 1893, pp. 69–70.)

VULVA, VAGINA, AND PENIS.

If the labia are parted it will be seen that the mucous membrane of the vagina is decidedly yellow, with petechiæ even more marked than in the eye (Griffith Evans, 1881, p. 3). When the petechiæ are well marked on the vulvæ of mares they are very suggestive of surra.

According to Lingard (1893, p. 78), serous effusion beneath the vulval membranes is not infrequent in mares, and Steel observes that "the irritation of these parts is, however, shown by frequent symptoms of 'horsing.' Indeed, in mares there is almost always in this disease a little reddish brown fluid dried about the external generative orifice, which discharge persists throughout the attack. The parallel to this sexual phenomenon of mares is seen in male animals, as frequent and quite uncalled-for erections of the penis, which may be due to irritation of the erection center in the cord, but possibly, also, is associated with the formation of clots in the erectile structure of the penis, which organ latterly in the attack remains permanently slightly protruded and turgid, or there may be embolic plugging in the vessels." (Lingard, 1893, p. 78.)

MUCOUS MEMBRANES.

The mucous membranes become yellow and petechiæ occur on one or the other; but these are not persistent, generally leaving entirely during the intermittent stage of the fever. (Vet. J., Lond., 1896, p. 177.) (See also "Tongue," p. 97; "Eyes," p. 94; "Nose," p. 95; "Vulva, vagina, and penis," p. 97.)

EXCRETIONS AND SECRETIONS.

URINE.

Quantity.—Griffith Evans (1881, p. 4) says that in some advanced cases the urine is passed more frequently and appears to be much more in quantity than normal, while Ranking (1891a, p. 399) describes the urine as abundant, and Nariman & Vaz (1893, p. 404) report that staling is frequent. According to Lingard (1893, p. 71), the quantity of urine in the early stage of the disease does not appear to vary to any great extent from that in health, but toward the end more is passed; but this must naturally depend to a large extent upon the amount of water taken by the animal during the 24 hours and upon the season of the year.

Color.—The urine of the horse in health when the animal is allowed to stand after exercise until cool, is turbid and yellow in color; carbonates of calcium and magnesium are precipitated. After inoculation with surra, the urine remains turbid, and becomes orange in color, and later of a dingy green or greenish yellow. If the kidneys become affected, the quantity secreted is diminished, the density of the fluid is increased, and the color changed to that of cream or a light-yellow ocher; the latter color lasts for a few days only, 4 at the most, and then the fluid becomes a greenish yellow or dirty orange. In some horses the fluid passed is very viscid, but not in all; however, in the case of mares it is usually so from the first, and remains so, as long as the urine is alkaline, but as soon as the fluid becomes acid, the viscidity as a rule diminishes. (Lingard, 1893, p. 71.)

According to Griffith Evans (1881, p. 3) the urine is highly colored (also Nariman & Vaz, 1893, p. 404), but may later become normal. The Veterinary Journal, London (1896, p. 178), states that the urine becomes viscid, dark yellow, orange, or orange green. In Burma (George H. Evans, 1899, p. 41) the urine of surra patients varies a great deal; sometimes it is viscid, other times not; in color, it varies from a reddish to a greenish yellow.

Bile pigments are frequently seen (Lingard, 1893, p. 71). Burke (1891, p. 268; 1897, p. 191) says that the urine contains much hemoglobin, which is set free by the destruction of the red blood corpuscles, and Ranking (1891a, p. 399) reports that in one fatal case a pigment was found "which was no doubt urohematoporphyrin," but no spectroscopic examination was made. According to the Veterinary Journal, London (1896, p. 178), blood is frequently present, while George H. Evans (1899, p. 41) says that blood is common.

Odor.—Lingard (1899, p. 24), in referring to surra among camels, says that the diagnosis is most surely made from the smell of the urine, which becomes very offensive.

Specific gravity.—The range observed in the specific gravity is very considerable, and in the same animal may differ widely from day to day. In the case of horse No. 72 it was as low as 1,004 on the 19th of October, 1892, and rose to 1,034 on the 20th, and to 1,046 on the 23d; the highest registered in any case was 1,055 (horse No. 26), 31st of October, 1891. (Lingard, 1893, p. 71.)

Reaction.—The reaction of the urine of horses is always alkaline in health, but varies according to the food given. In India the urine of animals fed upon oats is acid in reaction, while, on the contrary, when supplied with grass and gram the reaction is alkaline. When a horse is the subject of surra, especially in long-protracted cases, the urine remains alkaline until some 7 or 8 days before death, when it is found to change and become, respectively, feebly alkaline, at the expense of the carbonates of calcium and magnesium, neutral on the following day, then slightly acid, and finally strongly acid; and this acid condition of the secretion is maintained until death takes place; in some cases it lasts for as long as 6 days. (Lingard, 1893, p. 71.)

Nariman & Vaz (1893, p. 404) give the reaction as acid in advanced stages of the disease. In Burma (George H. Evans, 1899, p. 41) it is, as a rule, alkaline, but toward the close of the disease the reaction is often slightly or distinctly acid.

Urea.—Lingard (1893, p. 71) states that the quantity of urea passed during the paroxysms and apyrexial stages is at present under investigation. It appears, however, that the amount of urea excreted is increased to a considerable extent immediately after the parasite appears in the blood. During the paroxysms the amount undergoes a slight decrease, rising again during the absence of the hematozoon from the blood. It is a point of considerable interest that the maximum excretion of urea generally takes place during the second intermission, and after this period gradually diminishes with perhaps a slight occasional rise until the animal succumbs. This question, however, requires further investigation, and is now being carefully worked out.

Uric acid.—Uric acid is not increased in the horse, but in the ass it has been found to be present previous to inoculation, and to be absent after the appearance of the hematozoon in the blood. (Lingard, 1893, p. 71.)

Phosphates.—Phosphates are occasionally present, but in the great majority of cases are absent in any appreciable amount. (Lingard, 1893, p. 71.)

Albumen:—This does not appear until some little time after the first appearance of the hematozoon in the blood, and then only in small quantities, unless the animal develops signs of the kidneys being specially affected. In case No. 38 the animal presented well-marked symptoms of the kidneys having become involved. On examination of the urine, epithelium, blood, and granular casts were found daily; so that evidently the animal was the subject of an acute desquamative nephritis. (Lingard, 1893, p. 71.)

According to Ranking (1891, p. 399), Burke (1891, p. 268; 1897, p. 191), and the Veterinary Journal, London (1896, p. 178), the urine is frequently or usually albuminous. Nariman & Vaz (1893, p. 404) say that "later on" the urine is highly surcharged with albumen; while according to George H. Evans (1899, p. 41), in some cases of surra in Burma, small quantities of albumen may be present.

Casts.—Griffith Evans (1881, p. 5) failed to find casts, but George H. Evans (1899, p. 41) reports that granular-looking casts are common.

Sugar.—Sugar was not detected in a single case. (Lingard, 1893, p. 71.)

Parasites.—Parasites were not detected in the urine. (George H. Evans, 1899, p. 41.)

Retention and incontinence.—Retention and incontinence have not been observed in horses. (Lingard, 1893, p. 71.)

FECES.

Griffith Evans (1881, p. 3) did not find the dung abnormal in any case. He was told by the salootri, who laid great emphasis upon it, that the dung balls are sometimes coated with mucus, having red patches. "He showed me one of these; it was what we often find in health." Evans mentions, however, that in a few days after admission on the sick list the dung becomes normal. According to Lingard (1893, p. 70), the rule is that the bowels are constipated, although diarrhea coming on late in the disease is an occasional symptom. The stools retain for some time their natural color and consistency, but frequently become lighter than normal. At a later period they are usually coated with a layer of mucus of a light-brown color, the dung balls presenting a glazed appearance, or at times they may be tinged with blood. On microscopic examination of the brown mucus it is found to contain epithelium and a large number of colorless octohedral or polyhedral crystals. Toward the termination of a case, occasionally the dung becomes semisolid or pultaceous in consistency, and then emits a very foul odor.

Nariman & Vaz (1893, p. 405) refer to the feces in later stages as being "stinking and soft," and the Veterinary Journal, London (1896, p. 177), says that feces are, as a rule, normal throughout the attack, but occasionally there are signs of constipation, and at the termination of the disease there may be diarrhea.

In Burma, constipation is the rule, diarrhea the exception; dung is at first natural; later it is of a light-brown color, and toward the end of the disease it is frequently pultaceous and possesses a foul odor (George H. Evans, 1899, p. 41).

ACTION AND PARALYSIS.

According to Griffith Evans (1881, p. 2) the action is sluggish, occasionally with stumbling on the fore legs or dragging the hind legs on the ground. Burke (1891, p. 269; 1897, p. 191) says there is both an acute and a chronic form of paralysis—stringhalt, muscular tremors, crossing of legs, etc.; (1891, p. 271) in some cases of paralysis of the hind quarters, or other well-marked nervous symptoms, the gray matter of the cord generally shows blood extravasations and staining of the nerve cells, but beyond a tendency to congestion and occasional blood extravasation no lesions are usually discovered in the nervous system; (1897, p. 191) the symptoms described (stringhalt, muscular tremors, crossing of the legs) are due to some effusion of blood on the spinal cord or on particular nerves. Dragging of the hind toes is the result of muscular paralysis.

According to Nariman & Vaz (1893, pp. 404, 405) there is a dragging of the hind limbs and flinching on the slightest pressure over the loins; the animal begins to roll, is very unsteady in his gait, and prefers to lie down; soon the belly is tucked up; there is inability to rise; constant shivering followed by jugular pulsations, groaning, and death.

The Veterinary Journal, London (1896, p. 181), states that there is occasionally a considerable increase of fluid on the spinal cord about the lumbar region, which would probably account for the symptoms of paralysis sometimes present.

APPETITE AND THIRST.

Griffith Evans (1881, p. 2) describes the thirst as more or less abnormal, the appetite as capricious; (p. 3) later, the animal may refuse food, and there is great thirst. According to Steel (1886a, p. 169), in some cases the animals at last drop down and die suddenly, perhaps when they are eating and enjoying their food; in other cases they linger for days after they are down, too weak to rise, or too weak to stand after they are helped up; they may go on eating all the grass they get and much of the grain, until they die; it is remarkable how the animal in a state of semicoma will continue to eat grass almost without ceasing. Exceptions to this rule occur, for Lingard (1899, p. 61) examined an outbreak in which the most marked symptoms were *loss* of appetite, fever, emaciation, etc. Burke (1891, p. 269) says the appetite is greedy, or even voracious (1897, p. 191), but the debility appears progressive; the animal may continue to feed to the last. According to Nariman & Vaz (1893, p. 404), the appetite and thirst are hardly affected, but in many cases are abnormal. Later the appetite may be poor, the animal eating only a little lucern and grain; the thirst, however, is very great and there is profuse staling. The Veterinary Journal, London (1896, p. 177), says that the animals lose strength and condition, but the appetite remains good, except when the fever is very high, and even then green forage is eaten freely. The animals suffer greatly from thirst, and advantage is taken of this in administering medicine. Burke (1897, p. 191) states that the appetite is as good as in health. Lingard (1899, p. 60; 1900, p. 341) says that the appetite is ravenous. While in the horse the desire for food (also 1893, p. 70) usually ceases with supervention of fever, this disease is an extraordinary exception to the rule. In most cases, from the very onset of the disease until death, which may occur weeks or even months later, the animal may never cease to eat all the food placed before it, and in numerous cases under Lingard's observation the bedding was devoured during the night, the temperature at that time registering 41.2° C. (106.1° F.) or even as high as 42° C. (107.6° F.).

GURGLING.

From a very early period gurgling is present. In fact, it would not be overstepping the truth to say that this is a marked symptom in every case of this disease. It is frequently so pronounced as to be audible at some distance from the animal. (Lingard, 1893, p. 70.)

METEORISM, OR TYMPANITIS.

Meteorism is an occasional symptom which at times becomes sufficiently severe to require special treatment, but a brisk saline purgative is usually found to give great relief, though in some instances the symptom persists in spite of treatment. (Lingard, 1893, p. 70.)

RESPIRATION AND BREATH.

The respiratory movements are usually quickened from the first, sometimes out of all proportion to the pulse, so that they reach 60 to 65 in the minute, quite independent of any pulmonary complication. The respirations frequently appear to be entirely abdominal, and in these cases the ribs are not seen to move at all. It has frequently been noted that animals present a peculiar form of breathing when otherwise they appear fairly well, namely, eight or nine shallow respirations are immediately followed by a deep sonorous one, and this condition may last for several hours. Cheyne-Stokes[a] respiration was noted in one animal (No. 37) shortly before death. In this case the animal had, during the last few weeks of its life, suffered from severe kidney complications. (Lingard, 1893, p. 69.)

During the greater part of the period the disease lasts the breath is free from odor, but in the majority of cases, toward its last phases, it becomes very fetid, and in cases complicated with ozena; the mere name of ozena is sufficient to describe the offensiveness of the discharge. (Lingard, 1893, p. 69.)

According to Griffith Evans (1881, p. 3) the breath sometimes smells bad. Nariman & Vaz (1893, p. 404) state that respiration is quick and there is much panting on the slightest exertion, the latter symptom being well marked and often the first symptom to attract the owner's notice; they also refer (p. 405) to the breath as fetid in advanced stages of the disease. The Veterinary Journal, London (1896, p. 178), says that the respirations are usually proportionate to the amount of the fever, but there is seldom much distress, although the lungs are occasionally found more or less affected, and toward the end the breath becomes very fetid. (For a clinical chart of the respiration, according to Lingard (1893), the reader is referred to chart, under "Temperature," p. 104.)

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[a] A peculiar type of breathing in which there is a rhythmic increase of the respirations up to a certain degree of rapidity, then gradually decreasing again to temporary cessation. This pause may be as long as half a minute. This form of respiration is most commonly seen in the late stages of tuberculous meningitis, but it may also be noted in apoplexy, fatty degeneration of the heart, and nephritis with uremia.

HEART ACTION AND PULSE.

Griffith Evans (1881, p. 3) speaks of the pulse as being elevated, but a few days after admission to the hospital it lowers; (p. 4) in the last stages of the disease there is much anemic palpitation of the heart and the sound may be heard a little distance off.

Lingard (1893, pp. 68–69), in discussing the pulse and heart action, says:

"*The pulse.*—This is accelerated; it ranges between 30 and 90, and may reach 120 just before death, but varies considerably in the different types of cases recognized in this disease, not only in frequency but in rhythm and force. At the commencement the pulse increases in frequency upon the first rise of temperature, and continues to do so as long as the temperature becomes elevated during the latent period of the disease. On the appearance of the organism in the blood the pulse may fall somewhat, but again rises and remains so during the paroxysm of fever until the first apyrexial period, when it again falls to normal or thereabouts. A repetition of the above is observed in each fever and fever-free period until toward the termination of the case by death, when the pulse increases in frequency, and at the time of death may attain 120 beats to the minute, or even more. It will be of interest to examine the charts of horses Nos. 472 and 356 as examples of a point brought out by Steel, that 'the tracing from the number of pulse beats resembles that from thermometer readings.' In nearly every case of surra, at one period or another, and usually during one of fever, the pulse presents unmistakable signs of irregularity or intermission. I have noticed from one complete intermission in twelve beats down to as many as one in four; but in most instances a few hours later, or on the following day, no trace of irregularity existed. During a period of fever the pulse may vary considerably in frequency, according to the elevation of the temperature, with or without intermissions. The blood vessel during this time feels round and dilated with a moderate tension, the access of the pulsation is sudden and of short duration and its subsidence abrupt, but is fairly easy of compression between the beats, the walls of the vessel feeling smooth and elastic. But a marked change appears during an apyrexial period, the frequency is diminished or normal; in many instances there is some irregularity, or the pulse intermits; the beat is weak and thready, the access being gradual, its duration long and the subsidence slow, and the vessel feels flat, or, at the most, only half distended with blood.

"When the disease has been running on for a variable period, there comes a time, only a few days before death, when continued fever, usually accompanied by daily remissions, takes the place of the former type. During this period the pulse is increased in frequency, 65 to 72 beats per minute, regular, but bounding, forcible and large, reminding one of the force of the pulse of aortic regurgitations, but in surra the impulse is not visible in the carotids or in the superficial arteries. At the time of death the frequency of the pulse is greatly increased and may attain 120 or more beats per minute.

"*Action of the heart.*—As a rule there is nothing noticeable with regard to this organ until the disease is fairly advanced, when, after repeated attacks of fever, with the accompanying organisms in the blood, the animal becomes more and more dull and dejected in appearance. There is breathlessness on exertion, very often sleeplessness and inability to lie down, together with an incapacity for a sustained exertion. The heart's action then becomes exceedingly irritable, and at a later date, when the bounding pulse appears as a result of the condition of the organ, its action becomes violent and tumultuous, so that not only is the animal swayed backward and forward by it, but bystanders are able to hear the sounds at a distance of a few feet. At this time also jugular regurgitation is observed, and distention of the superficial veins of the body, particularly those of the head and the large external or subcutaneous thoracic vein, running from the flank toward the olecranon region."

For a clinical chart of the pulse, after Lingard (1893), see chart under "Temperature."

Nariman & Vaz (1893, p. 404) describe the pulse as frequent and soft. Later it becomes soft and irregular, often accompanied with palpitation of the heart. According to the Veterinary Journal, London (1896, p. 179), the heart action becomes irritable and (if the case is nearing a fatal termination) weak, with frequent and often distressful anemic palpitation.

TEMPERATURE.

Surra is characterized by an intermittent, remittent, and sometimes a relapsing type of fever, which continues for varying periods, from a day to months, according to the species and the animals attacked (Lingard, 1893, p. 1). In discussing the temperature more in detail Lingard (1893, pp. 67–68) says:

"In the following, for the sake of description, the peculiarities met with in the temperature will be dealt with—

"(I) During the latent period.

"(II) From the discovery of the hematozoon in the blood until death.

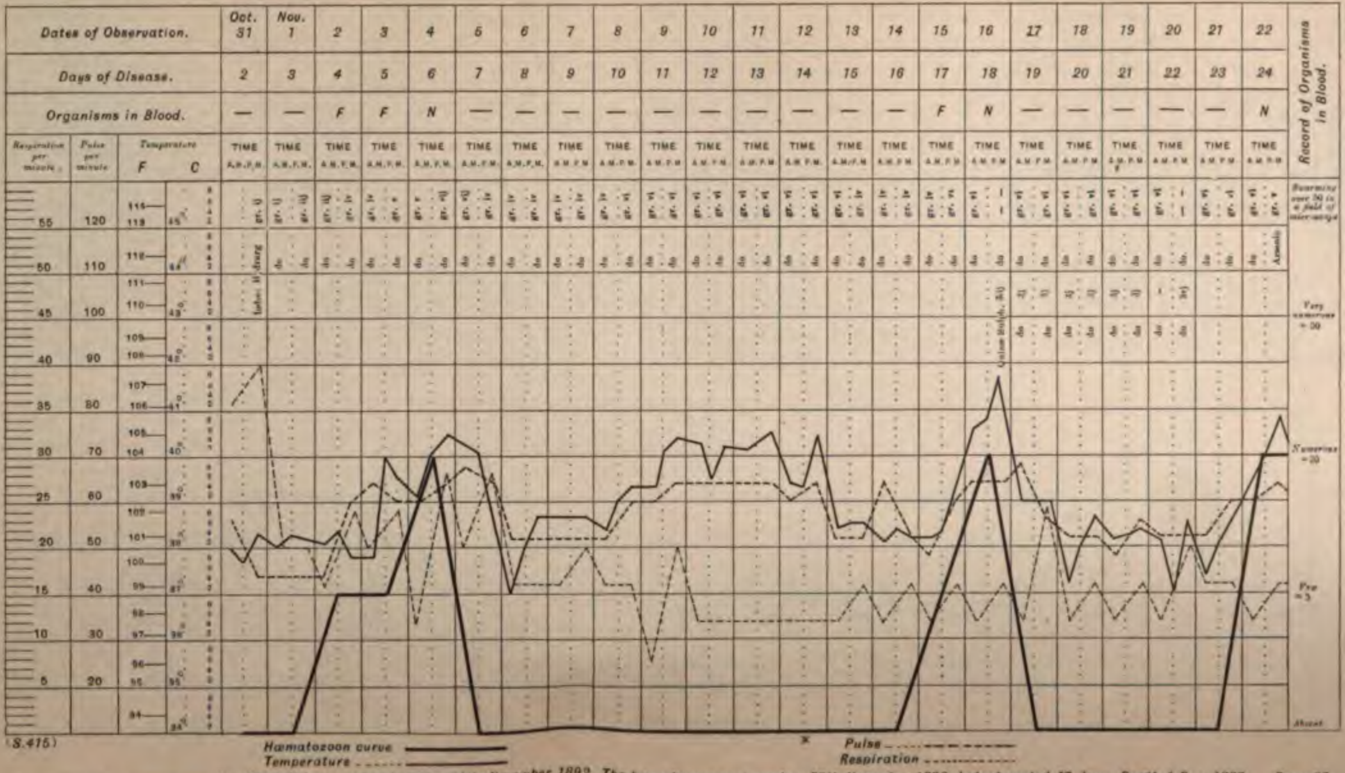
"(I) *Temperature during the latent period.*—Unfortunately we have no records dealing with the temperature of animals during the incubative period in naturally contracted cases of surra. We can, however, easily conceive the reason for this want, knowing, as we do, the insidious nature of the onset of the disease and the difficulty there is in deciding when any particular animal was exposed to the contagion. By experimental means, however, we are enabled to obtain an insight into this question, and on studying the charts presented with the following cases it will be found that the thermometric records present considerable variations, in that several different types of temperature curves will be observed during the abovementioned period.

"In one set of cases the temperature remains low for a few days and then commences to rise, the morning and evening reading being about half a degree Centigrade higher than that of the day preceding, but there being a temporary arrest or remission of 1.5° to 2° C. in the morning.

"In a second series of cases the curve delineated by the temperature readings presents for a varying period a diurnal variation, in some cases showing well-marked intermissions, in others hardly amounting to a remission; and these are followed by a sudden rise of temperature in a few just previous to or, in the majority of cases, *subsequent to the* appearance of the organism in the blood.

Australian Gelding ______ Age, 7 ______ Sex, Gelding ______ Colour, Brown ______

Disease, "Surra" naturally contracted. ______ Date of Attack, 30. 10. 92 ______ Result, Death ______ Date of Result, 17. 2. 93 ______ Register No. ______ LXXIII ______



× Inoculated 3 Guinea Pigs with blood
(i) Blood 0-2 c.c. inoculated on 12th. November 1892. The hæmatozoon appeared on 29th. November 1892. Latent period-17 days. Death 4 Dec. 1892 Days 22
(ii) " 0-25 c.c. " " " " " 24 " " " 12 " 25 Feb. 1893 " 105
(iii) " 0-3 c.c. " " " " " 24 " " " 12 " 12 March 1893 " 120

FIG. 89.—TEMPERATURE CHART OF SURRA DISEASE OF HORSE.

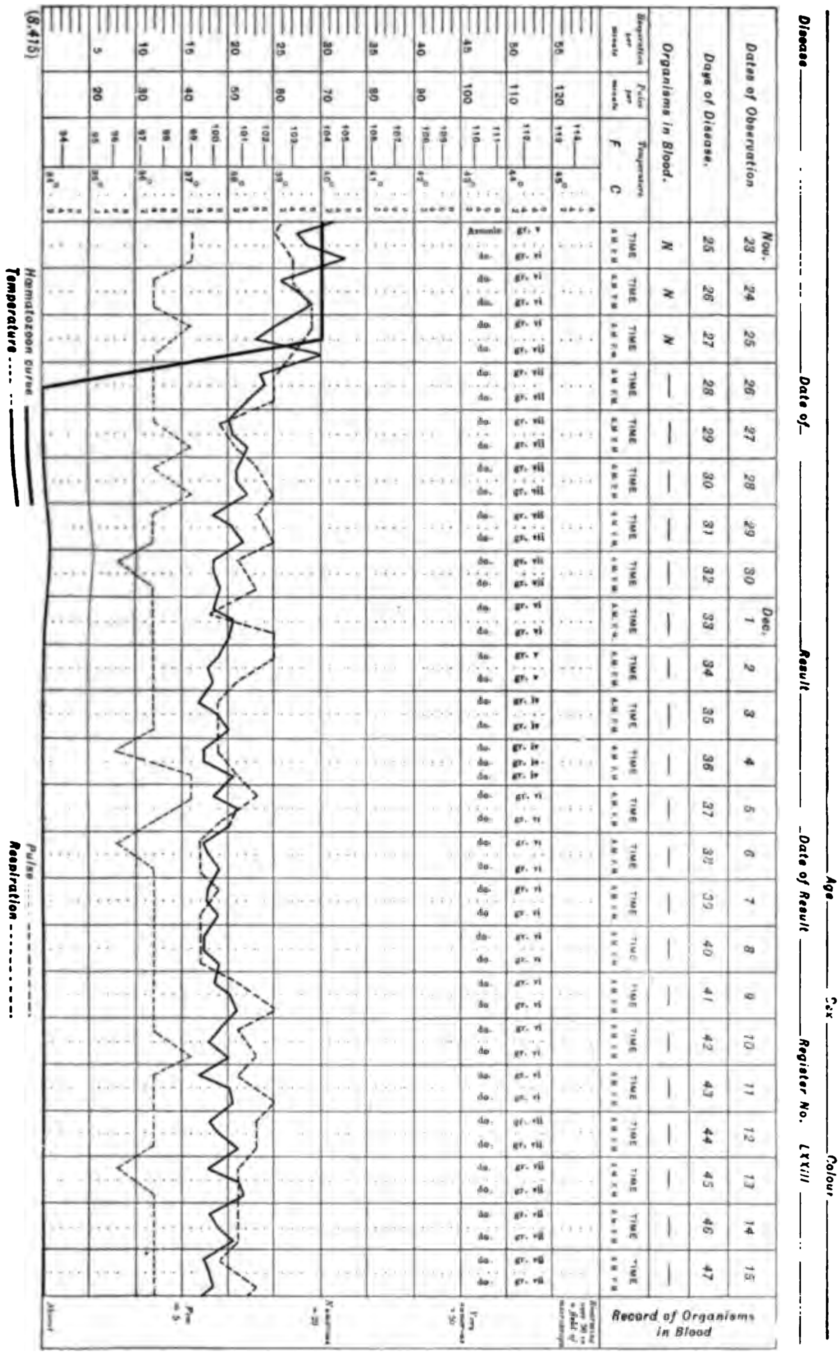


Fig. 90.—Temperature Chart of Surra Disease of Horse.

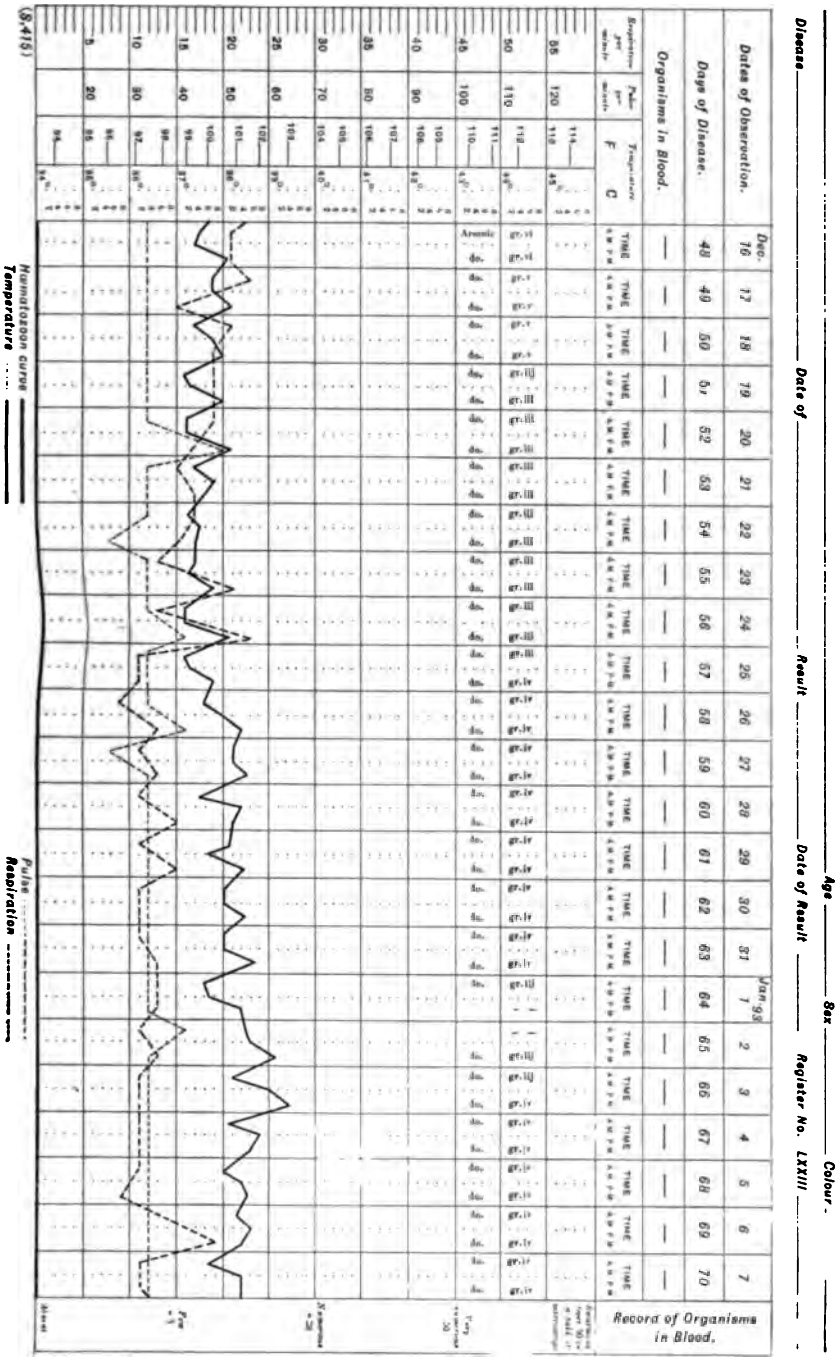


FIG. 91.—TEMPERATURE CHART OF SURRA DISEASE OF HORSE.

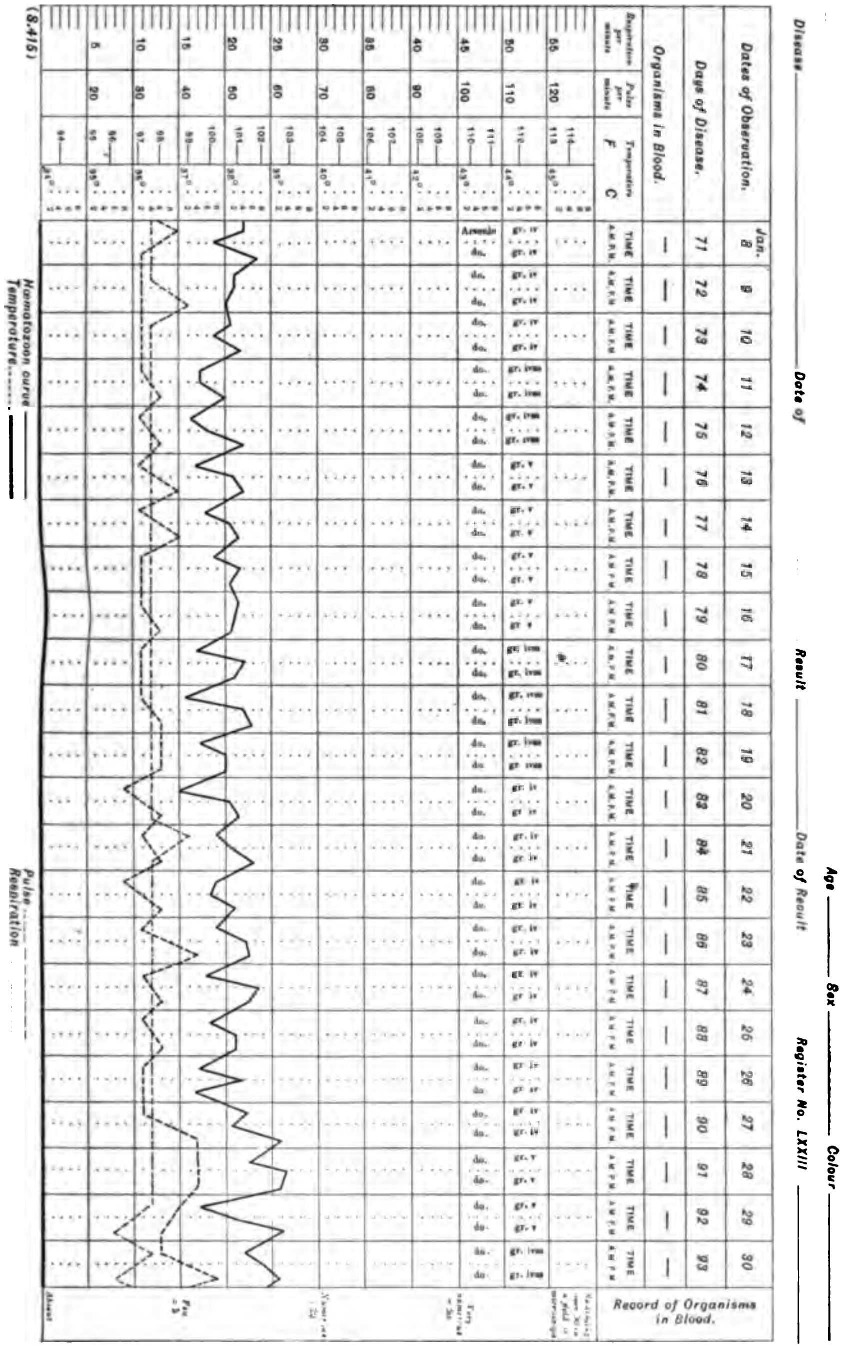
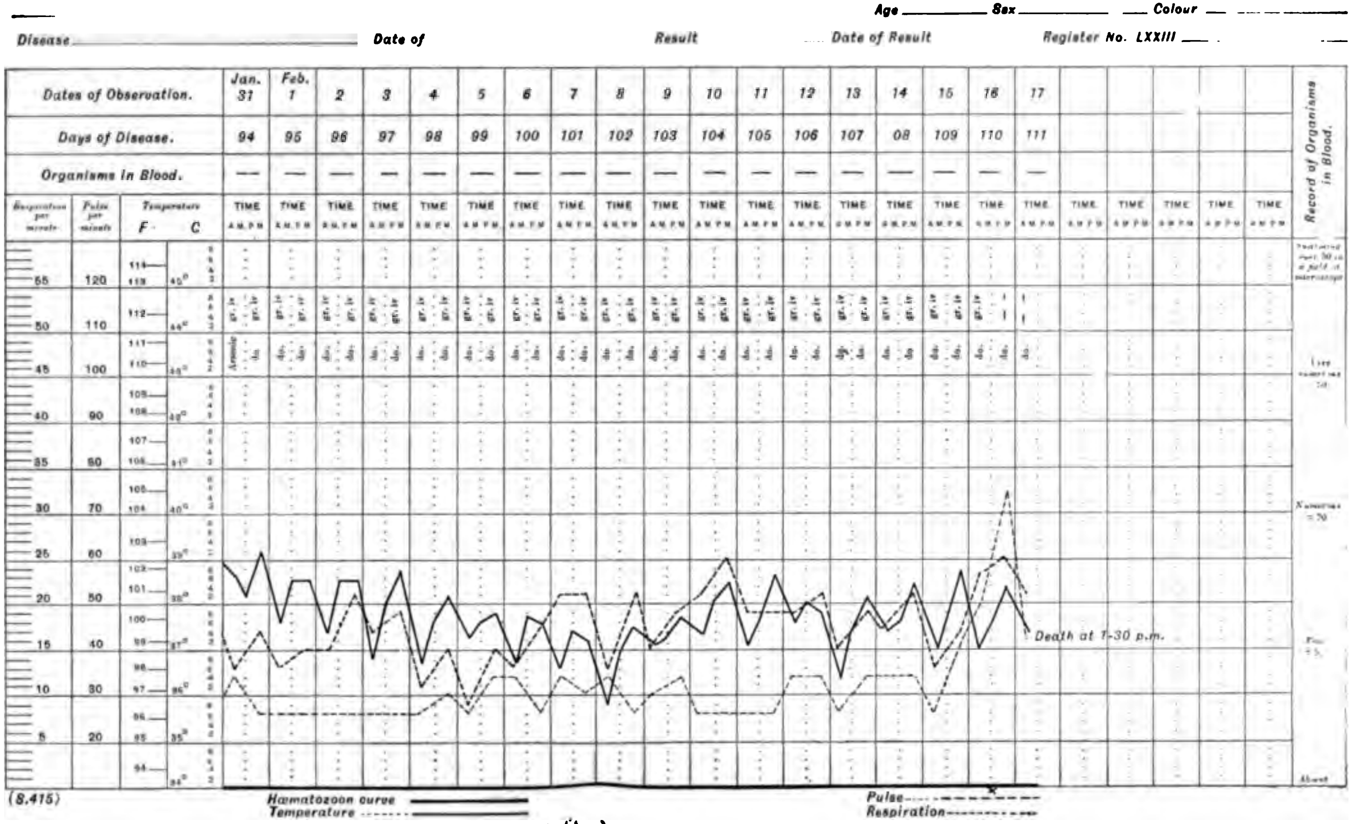


FIG. 92.—TEMPERATURE CHART OF SURRA DISEASE OF HORSE.



× Inoculated two Guinea Pigs. } 16.2.98. (I) Blood 0-5 c.c. (II) " 0-5 c.c. } Hæmatozoon absent.

Fig. 93.—Temperature Chart of Surra Disease of Horse.

Australian Gelding —— *Age, Aged* —— *Sex, Gelding* —— *Colour, Grey* ——

Disease, "Surra" naturally acquired —— *Date of Attack, 23rd. Sept: 1892* —— *Result, Death* —— *Date of Result* —— *Register No.* *LXX.*

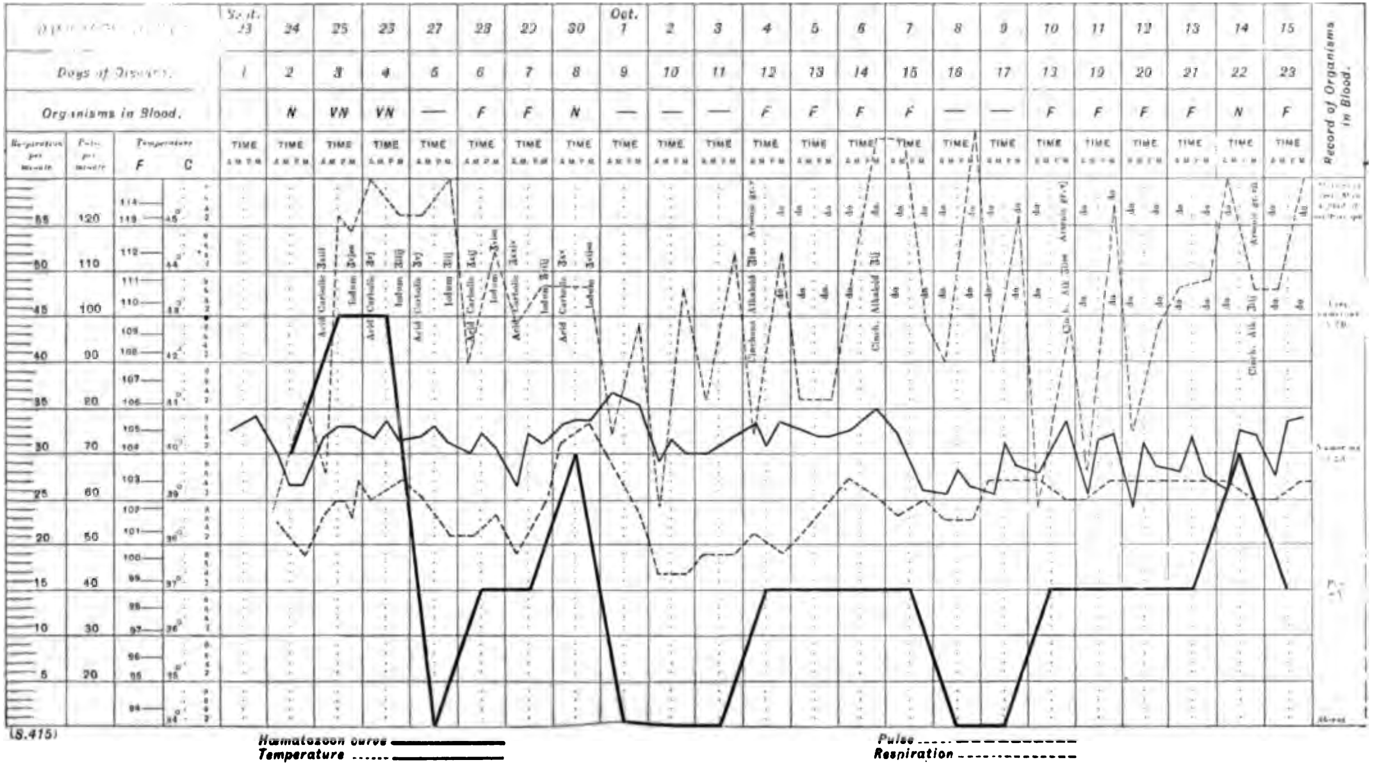


FIG. 94.—TEMPERATURE CHART OF SURRA DISEASE OF HORSE.

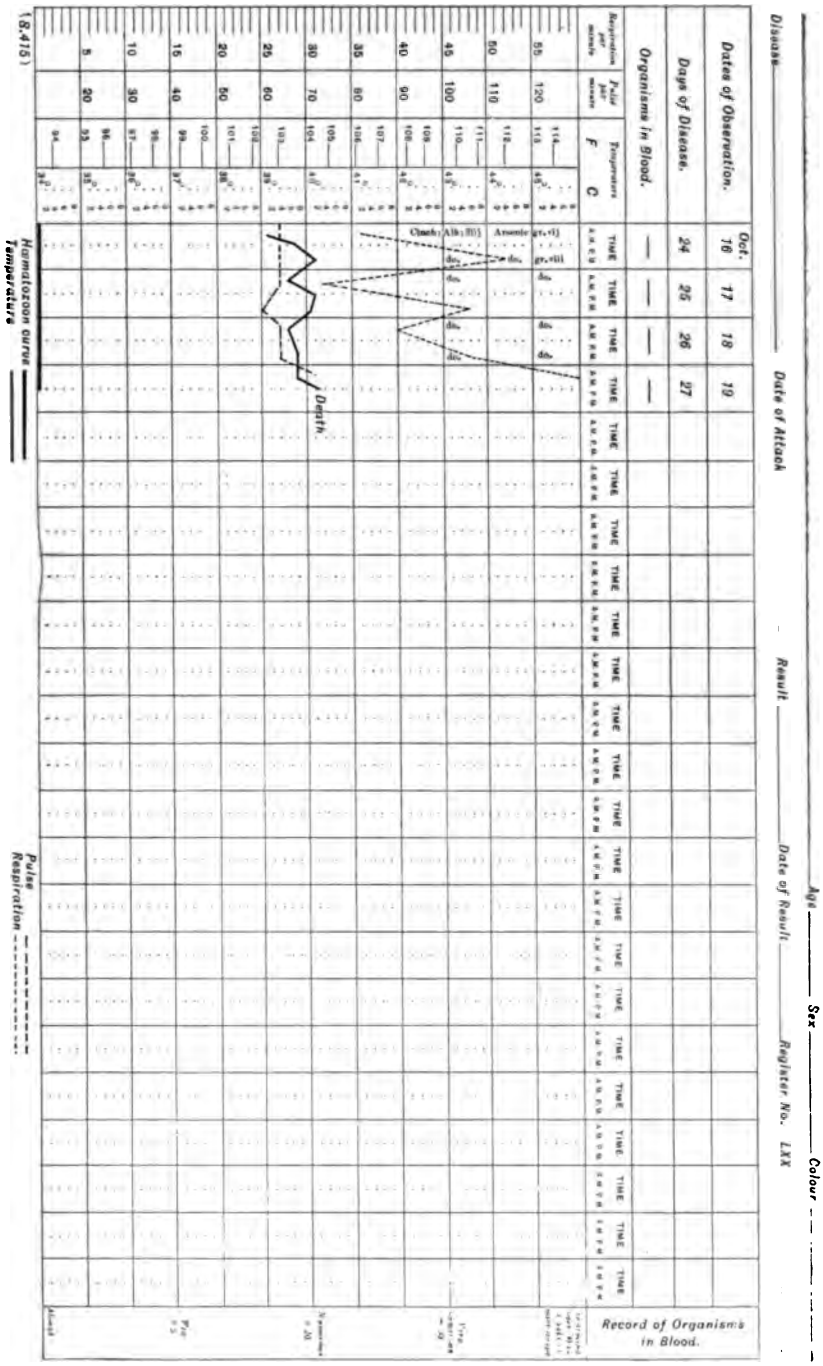


FIG. 95.—TEMPERATURE CHART OF SURRA DISEASE OF HORSE.

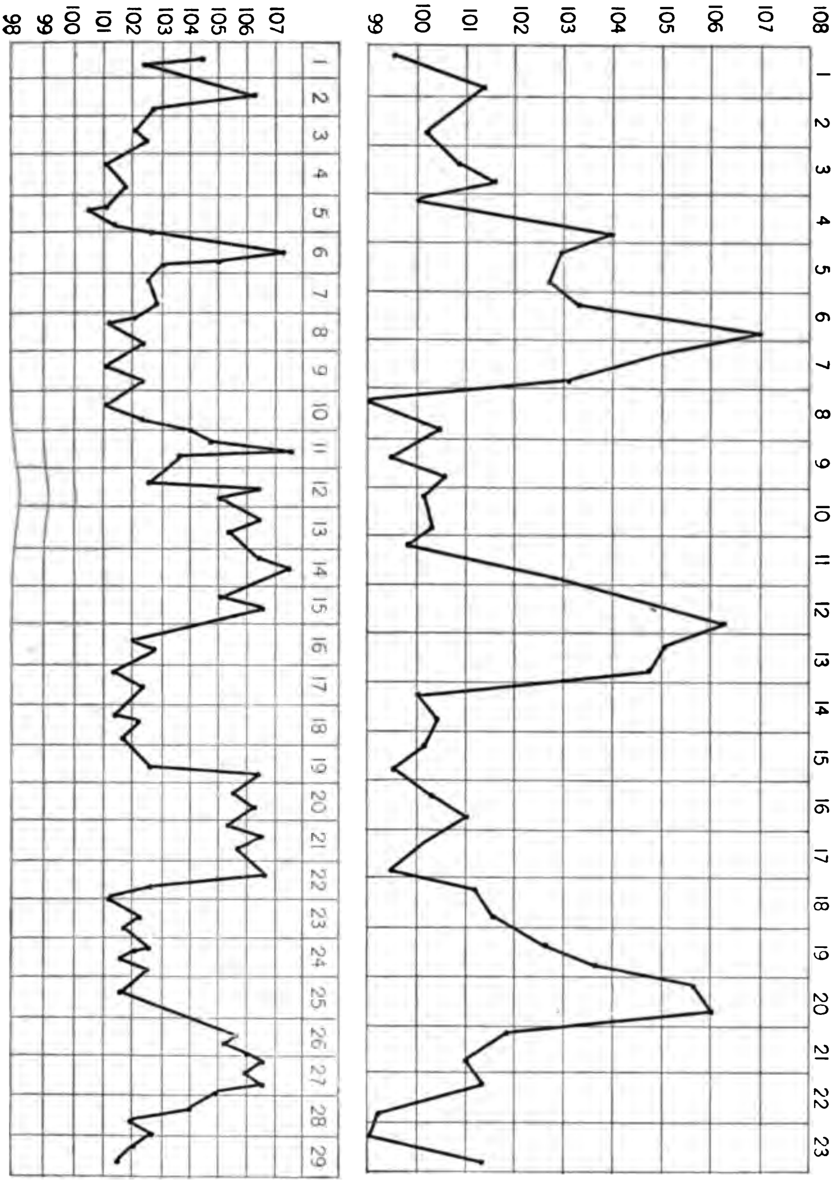


FIG. 96.—SURRA FEVER IN THE HORSE.

"In a third series the thermometer registers a normal or even subnormal temperature from the time of inoculation until the appearance of the organism in the blood, and this condition has occasionally been observed to persist after the discovery of the hematozoon.

"In a fourth series the temperature commences to rise either gradually or suddenly after inoculation, and attains a maximum varying from 39.2° to 41.2° C., which it maintains for a brief period. It then falls quickly or gradually to a normal or a subnormal minimum, either at the same time or just previous to the first appearance of the hematozoon in the gluteal circulation.

"(II) *The temperature from the discovery of the hematozoon in the blood until death.*—The type of fever appears to vary in different outbreaks of surra, changing according to the locality in which it occurs and the animal affected. In Burmah, Steel described the fever in mules as being of a relapsing type, and there is no doubt that the charts recorded in two cases of the naturally contracted disease bear out his opinion.

"In the cases which have come under our observation animals suffering from the naturally contracted and inoculated disease present at least two varieties of types:

"(1) A continued fever accompanied at tolerably frequent intervals by remissions more or less marked, and after a varying period of days by an intermission of longer or shorter duration. These changes may be repeated several times in the course of the disease. When, however, it arrives at its last stage the thermometer reveals a continued high temperature of a remittent type, or one characterized by morning remissions, and evening exacerbations until death.

"(2) A second and much rarer form is one which may be conveniently divided into three stages. In the first a continuous fever, accompanied by remissions, is present for some days. This is followed by a succession of periods lasting two to five days, each individual period being made up of a gradual or more sudden rise from the normal to 40° or 41° C., or even higher, when it attains a maximum, and after a short time is followed by an abatement of the fever, indicated by a sudden fall in temperature from 2° to 4° C., which may become normal or subnormal, and on such occasions this is succeeded by a period of apyrexia. In the third stage the fever may again take on a continued type, which is not always continuous, but remains high and oscillates freely until death.

"(3) Cases may be rapidly fatal with the temperature remaining subnormal during the whole course of the disease. Vide cases Nos. 32 (35.4° to 38° C.), 30 (35.7° to 38.8° C. just before death), 41 (35° to 37.6° C.), 27 (normal and subnormal, never over 38.7° C.).

"In some instances there may be a sudden rise in temperature just before death, but in the majority of cases there is a fall. In 30 cases under our observation death was followed in 18 by a fall in the temperature varying between 0.5° and 3°C., in 10 by a rise varying between 0.5° and 4° C., and in 2 neither rise nor fall took place."

Burke (1888a, p. 2), in referring to fever, says that its periodicity is perhaps the most characteristic feature, but it is after all an uncertain guide.

The temperature does not often rise above 104° F. (110° F., Steel, 1886a), and may fall as low as 97°. The highest temperature may be followed by a gradual fall and may rise again gradually, until after an interval of 5 or 6 days, the maximum is reached, then there is a fall, or there may be diurnal exacerbations, recalling the temperature chart of malaria in man. Burke (1897, p. 191) remarks that in some cases "the symptomatic course of the disease is very clearly and definitely marked, the first thing, of course, being the recurring elevation of temperature which is so clearly observed in the human subject." Pease (1897, p. 555), on the other hand, remarks that while *Plasmodium malariæ* causes a distinct intermittent fever, *Trypanosoma* does not, and there is no regularity in the course. In malaria the stadia are short and sharp, lasting but a few hours, while the fever of surra lasts for days, and for extremely irregular periods of time in the course of the same case. Nariman & Vaz (1893, p. 404) speak of the high fever which is periodical, the exacerbations lasting from 5 to 7 days, while the intervals are little shorter. In exceptionally severe cases the exacerbations run to even 10 days, while in mild cases they may not be more than 3 days in duration. Further, it is only during the febrile periods that the other symptoms are marked, but between times the animals are dull and drowsy.

A few days after admission to the hospital the activity of the fever subsides, pulse lowers, and temperature becomes normal.

According to Lingard (1899), the following variations in the temperature of healthy animals were observed at the Imperial Bacteriological Laboratory in India:

Animal.	Centigrade.	Fahrenheit.	Animal.	Centigrade.	Fahrenheit.
Horse	37.2 to 38.3	99 to 101	Cat	37 to 38.6	98.6 to 101.5
Donkey	35.8 to 36.6	96.4 to 97.8	Rabbit	38.8 to 39.8	101.8 to 103.6
Ox	37.7 to 38.3	100 to 101	Guinea pig	38.4 to 39.4	101.1 to 103
Sheep	39.4 to 40	103 to 104.7	Fowl	41 to 42.6	105.8 to 108.7
Goat	38.8 to 40.2	101.8 to 104.3	Pigeon	41 to 43	105.8 to 109.4
Dog	37 to 39.8	98.6 to 103.6			

For horses suffering from surra Griffith Evans (1881, 1882) gives a number of tables of temperature and pulse.

Lingard (1893) gives numerous charts of temperature, pulse, re
piration, and hematozoa, from which plates IX to XV are reproduc
for this report.

Two further temperature charts are here added, based upon observations of still a third observer, Pease (1897, pp. 562, 564).

For comparison with these charts of the horse, the followin
servations on a mule, by Steel (1886a, pp. 171-172), may be note

> "In the mule there are certain peculiarities of different cases worthy of no
> Mule No. 13.—Experimentally I obtained the most typical chart from a case i
> by the administration of mixed blood (containing spirilloids) and water as
> to a thickset mule in good condition. The effects were as follows:
>
> "(*a*) An evanescent rise in temperature of nearly 2° on the evening o
> ment.
>
> "(*b*) An *incubation* of 6 days.
>
> "(*c*) On sixth day after inoculation the *invasion* rise began; it was 5° t
> one-half degree in 2 successive days (eighth and ninth) to 105°, a fall of
> day, of over 3° *to the normal* on eleventh day. No appreciable rebound.

"(*d*) *First fever-free interval* of two days (twelfth and thirteenth).

"(*e*) *First relapse.* A rise through 3.5° first day, 1° second day, 2° third day, to a maximum of 106.5° F. A fall through 4° on first day and 2.5° on second day *to the normal.*

"(*f*) *Second fever-free interval* of 2 days.

"(*g*) *Third relapse.* Rise through 1.5° first day, one-half degree second day, one-half degree third day, to 102.5°. The reading remains here for fourth day, and then on fifth day falls to normal, and on sixth day *below normal.*

"(*h*) A slight *rebound* on seventh day, then fall to below normal.

"(*i*) *Two days interval,* below normal.

"(*j*) *Fourth relapse.* Rise through 1° on first and 3° on second day to 103°, a fall of 2° daily to normal on second day.

"(*k*) The temperature remains normal 1 day (thirty-fourth after inoculation).

"(*l*) The next 9 days are occupied by three acute rises to 103°, 104°, and 104°, respectively, separated by two imperfect falls to 100° on third day and to 101° on fifth day. On the ninth of these days the reading is a little below the normal.

"(*m*) It remains so 1 day.

"(*n*) The next 6 days occupied by three rises and three falls on alternate days (104/100), (102/101), (102/99).

"(*o*) The temperature remains about normal 2 days, then rises 2 days through 103° to 103.5°, falls to 101°, rises to 102°, falls to 99.5°, rises to 105.5°. Then falls in 2 days (through 101°) to 99°.

"(*p*) It rises to 101° next day, remains so 1 more day, then up to 103°, down to 101°, up to 105°. Then a marked fall to 98.5°.

"(*q*) Rise to 99°; rise to 105°; fall to 100.5°; remains so for 2 days.

"(*r*) Rise to 105°. Then fall for 3 days (102°—99°—to 98°); remains so 1 day.

"(*s*) Rise to 104°; fall to 101°; remains so 1 day.

"Observation ceases after 83 days from rise. The deductions to be made from this prolonged record are that after an incubation of 6 days three fever phases can be observed, each consisting of a rise for 3 days and a fall for 2 days, and these are separated from each other by intervals of 2 days, during which the temperature regains the normal. Then occur less regular rises, variable in degree, and separated by depressions variable in degree, but seldom below the normal until toward the last. There is a tendency of the rises to group in threes. The parasites were in this case most often found at the periods of most fever. It is hardly practicable to determine the number of relapses here. The case was 77 days under observation after the first rise of temperature."

PATHOLOGY.

Postmortem examination does not reveal any structural disease (Griffith Evans, 1881, p. 6). No structural changes were noticed in the kidneys, liver, spleen, heart, lungs, and mucous membrane of the stomach and intestines. According to Lingard (1893, p. 2), there is no specific lesion present; (p. 80) the most important element is the presence of actively moving parasites in the blood.

RIGOR MORTIS.

Rigor mortis is normal, and carcasses of animals which have died of surra present a dreadfully emaciated appearance, seeming to be composed of only skin and bones (George H. Evans, 1899, p. 38).

ANEMIA.

According to Griffith Evans (1881, p. 3), the membranes are blanched. Burke (1888a, p. 3) says there is marked anemia and leucocytosis; (p. 8) extreme pallidity of all the tissues, with perhaps a trifling serous effusion into the abdomen. Later (1891, p. 270; 1897, p. 188) he states that very often there is an acute dropsy, with no other postmortem lesions save extreme anemia and yellow staining of the tissues, due to fatty degeneration.

SEROUS EFFUSIONS.

According to Griffith Evans (1881, p. 6), there is more or less clear serum effused into the peritoneal cavity in all cases, with a slight coating of lymph upon the parietal layer, but there is no sign of any inflammatory action; it is a simple exudation. There is no abnormal effusion in the pleural cavity, but in one case the pericardial sac was greatly distended with fluid. According to George H. Evans (1899, p. 38), there may be an excess of fluid in the abdominal and thoracic cavities, also in the pericardial sac.

PETECHIÆ.

Griffith Evans (1881, pp. 6–7) says that in some cases petechiæ were found on the mucous lining of the intestine similar to those on the vagina and eyelids. According to Steel (1886a, p. 169), the petechiæ seem to appear when the temperature curve begins to fall and the parasites have attained their maximum activity and frequency. The skin occasionally, and the mucous membranes of the mouth and nostrils frequently, are the seat of petechiæ and of very limited degenerations from malnutrition, probably the result of plugging of their small nutrient vessels. We see this plugging on a much larger scale bringing about a defective supply of blood to the limbs, especially the hind ones, for antemortem clots are frequent in this disorder, and may prove the immediate cause of death. The Veterinary Journal, London (1896, p. 181), reports petechiæ on the kidneys. Hayes (1898, p. 481) says there are petechiæ on various internal organs.

JAUNDICE.

According to Griffith Evans (1881, p. 4), the yellowness of the mucous membranes, or jaundice, and the petechiæ remain throughout, though they are variable in intensity.

Lingard (1893, p. 70) says that tingeing of the membranes is a very constant symptom in every case at one period or another. It sometimes is a very early one, and at others does not make its appearance until well on in the disease. It may be evanescent in character, appearing with each paroxysm and gradually fading during the intermission, until the membranes become perfectly free and pallid, only to return with each exacerbation of the fever. In a second series of cases the color is intense and persists until death, when the tissues of the body will be found to present a deep crude gamboge color. Even when there is little or no tingeing of the mucous membranes at the time of death the gelatinous exudation found so constantly in this disease is always more or less tinged from a light yellow to a deep orange color, and the material surrounding the base of the heart may be specially mentioned as being one of the most certain localities in which to observe it. Nariman & Vaz (1893, p. 404) say there is a well-marked jaundice denoted by the yellowness of the membranes.

FATTY CHANGES.

Burke (1888a, p. 3) states that there is fatty degeneration of the muscles, liver, spleen, kidneys, and other organs. Later (1891, p. 270; 1897, p. 188) he says that there is a large deposit of fat all over the body, especially noticeable under the skin. This gives the tissues a peculiar, jaundiced appearance, which is shown under the microscope to be due to the deposition of fat globules.

ORGANS AND TISSUES.

MUCOUS MEMBRANES.

According to Griffith Evans (1881, pp. 6–7), the mucous membranes everywhere are more or less tinged with yellow, and often the subperitoneal connective tissue is yellow also. According to Hayes (1898, p. 481), the mucous membranes and other tissues are frequently tinged yellow with coloring matter of the bile. (See also "Eyes," p. 94; "Nose," p. 95; "Mouth," p. 97; "Vulva," p. 97; "Stomach," p. 114; "Intestines," p. 115.)

HEART AND BLOOD VESSELS.

Steel (1886a, p. 171) records fatty changes in the heart. He also refers to "green gelatinous extravasations between the muscles of the thighs; greenish white blood clots in the larger blood vessels (a short time after death); antemortem clots, especially in the large blood vessels of the hind limbs."

Lingard (1893, pp. 82–83) gives the following lesions for the heart:

> "The cavity of the pericardium generally contains more or less fluid presenting an amber or orange color, and in severe cases it is found deeply tinged with blood. Pericarditis has not been observed.
>
> "*The heart* generally presents some abnormal appearance. The base is frequently the seat of a yellow or orange-colored deposit of gelatinous exudation, which takes the place of the usual fat. This exudation in the great majority of cases is dotted over with small circular ecchymoses, dark red or nearly purple in color, which lie under the visceral pericardium singly or in groups, and sometimes assume the pro-

portions of extravasations. These are also found, but less frequently, invading the external surface of the muscular tissue of the organ, and a common situation for them also is on either side of the coronary vessels.

"The right side of the heart is in most instances dilated, the left side contracted. The muscular tissue is often pale and flabby, and in a state of fatty degeneration.

"The cavities of the right side of the heart, and much less frequently the left, are distended with clots, which present a variety of colors ranging from yellow or orange to green and dark purple. These may be found bathed in dark semifluid blood. These coagula run up the great vessels from the cavities of the organ, and on gentle traction can be detached, and are found to reproduce the branching and peculiarities of the vessel which they occupied. The lining membrane of the right auricle and ventricle, and much less frequently the cavities on the left side, are observed to be stained a dusky red or claret color; but the pathological change, which gauges the gravity of the disease in each individual case, must be looked for and estimated by the number and extent of the subendocardial extravasations. These in cases under treatment, when the hematozoon has been absent for some 10 days, have been found to be entirely absent. In other cases they may be represented by a few petechiæ, and again in more severe attacks extensive extravasations of blood may be present. These subendocardial changes are usually more frequently present in the right ventricle than in the left, and have been noticed in the cavities on the right side of the heart, when they have been entirely absent from the left. They are least frequently found in the left auricle. A common situation for them to occupy is the surface of the musculi papillares, but they may appear on any portion of the muscular wall of the cavity, as well as frequently involving the inner surface of the flaps of the tricuspid and mitral valves. The ventricles occasionally present well-marked signs of fatty degeneration, and, although in the human being the left is the more frequently affected, in these cases the right ventricle has been observed to present the most marked changes, near to the apex of the organ. In cases where the visible mucous membranes have been stained yellow during life, the same coloration of the tissues of the internal surface of the heart has been found well marked. In all the cases the yellow deposit of gelatinous material was present round the base of the organ.

"*Naturally contracted.*—In four of these cases ecchymoses or more extensive extravasations were found on the external surface, lying under the visceral pericardium and well marked in one. Subendocardial extravasations were present on the bicuspid valves in Nos. 56 and 70, and involving the tricuspid valve in No. 70.

"*Inoculated cases.*—In 12 cases ecchymoses were present on the external surface of the heart and internal subendocardial extravasations, as follows:

"In the right auricle, in 2; in the right ventricle, in 12; in the left auricle, in 3; in the left ventricle, in 14.

"The musculi papillares were involved in 4 cases."

Nariman & Vaz (1893, p. 405) also mention gelatinous yellow deposits in the furrows of the heart and often extensive petechiæ under the endocardium. Hayes (1898, p. 481) says there is a yellow or amber jelly-like exudate in the connective tissue of the throat, chest, abdomen, and about the muscles and other tissues, and especially around the base of the heart.

According to George H. Evans (1899, p. 38) the heart has gelatinous accumulations in its furrows instead of fat. In chronic cases the organ is pale, flabby, very often enlarged, and very soft. The cavities are filled with blood or variegated clots, which extend into the great vessels. On several occasions he has observed an atheromatous condition of the aorta. The heart constantly presents some abnormal condition, the more frequent being more or less extensive subendocardial ecchymoses.

At the base of the heart there is almost invariably a yellow deposit of orange-colored gelatinous material, and the cavities of the heart contain clots of a yellow, green, orange, and purple color, bathed in tarry dark blood. (Vet. J., Lond., 1896, p. 181. See also p. 92, under "Edema.")

Blood, anemia, leucocytosis, and parasites.—According to the more careful observers, there are three things in particular to be noticed in connection with the blood, namely: (1) The presence of the parasites, (2) a destruction of the red-blood corpuscles, and (3) a marked increase of the white corpuscles. Steel (1886a, p. 169) says that frequent dropsies and sluggish vitality of all the tissues indicate the depraved state of the blood. Burke (1888a, p. 9) states that leucocytosis is characteristic of surra, being always present in typical cases.

The Veterinary Journal, London (1896, p. 178), records that at first the blood appears normal, but later a peculiar vibration may be observed, caused by some rapidly moving indefinable organisms among the corpuscles. Later the white corpuscles increase in number, and the red corpuscles, from the attacks made upon them by the hematozoa, become irregular in shape, many of them appearing to be irregular granulated gelatinous masses of a pale color, which form into irregular rouleaux. In the last stages of the disease the plasma occasionally assumes a faint rusty tinge; the parasite attacks the red corpuscle, takes hold of it, tears it, and worries it as a dog would a rat. Griffith Evans (1881, p. 181) records that the hematozoa always fasten to the blood corpuscles by their blunt end, showing a great preference for the concave side of the disk rather than the edge, and breaking up the corpuscle. Burke (1888a, p. 84) and others also describe the attacks on the corpuscles as being a tearing, dragging, or tugging. The white corpuscles are said not to be attacked by the *Trypanosoma*. Lingard (1893, p. 28) estimates as many as 300,000 parasites for 1 c. c. of blood. Nariman & Vaz (1893, p. 405) say that the corpuscles appear to be broken, and many small granules are seen, some of which are freely movable. No parasites were found in the secretions. Nariman believes that between the febrile attacks the hematozoa accumulate in the liver and spleen; for after death, when no parasites are seen in the blood, examinations of scrapings from both liver and spleen show fast-moving round bodies, like the corpuscles. Ranking (1891a, pp. 400–401), who did not admit that surra was due to *Trypanosoma*, and who considered a "bacillus" as the exciting cause, claimed to have noticed "very characteristic changes" in the blood corpuscles. He says:

> "*Echinosis.*—At one period they present a peculiar appearance, to which I have given the name of echinosis, for the reason that the individual corpuscles have lost their normal contour and resemble nothing so much as an *Echinus*. * * *

"*Plasmodic.*—At another period, or in some corpuscles at the same period, the interior of the corpuscle is seen to be occupied by a foreign substance presenting ameboid movements and of very various forms, varying from circular throughout stellate and pileate forms to a veritable bacillar form—straight, curved, or spiral. These bodies, I take it, are comparable to, if not identical with, the *Plasmodium malariæ* of Marchiafava and Celli, as they correspond in all particulars, both of morphology and development, with those organisms. In one specimen only have I found the spirillum (*Hæmatomonas*) (*Spirochæt*), hitherto considered to be the effective cause of surra; whereas the organism, whose nature is now described, is invariably present and conforms in all particulars to Koch's postulates. * * *

"*Echinoid stage.*—The blood, then, of a surra animal, when in the stage of 'echinosis,' contains red cells, to the surface of which are adherent, or in the substance of which are embedded, minute circular organisms varying in size from 0.0004 mm. to 0.002 mm. in diameter. * * *

"In some stages these circular organisms, which I shall for the future call 'spores,' are seen free in the plasma in variable quantities exhibiting actively motile properties. They attach themselves to the surface of the red-blood disks, giving rise to the 'echidnoid' corpuscles of early echinosis.

"*Plasmodic stage.*—After a variable time the cells lose their *echinoid* appearance and become *plasmodic;* that is to say, they become occupied by the bodies mentioned above, and compared to the *Plasmodium malariæ*. These plasmodic corpuscles are of irregular contour in most instances, only retaining their disk shape in those cases in which the plasmodium is circular; in other cases assuming more or less the shape of the plasmodium contained in them.

"*Spore stage.*—After a further period the plasmodia break up, undergoing rapid fission into 'spores,' 0.002 mm. in diameter, which escape from the blood cell causing 'late echinosis,' and become free in the plasma. The changes must be observed on a warm stage.

"The red cell, having lost the spores, almost immediately resumes its normal contour, but only for an instant, as it rapidly loses all coloring matter and becomes translucent and all but invisible. These decolorized red cells may again be brought into view by adding a little watery Spiller.

"If now a slide, in which these appearances have been watched, is treated in the usual way for staining spores, it is seen to be full of minute deeply stained spores in a fibrinous reticular stroma, to the meshes of which the spores adhere.

"In addition to the above organisms, the following objects are seen with varying frequency:

"(*a*). Colorless wandering masses of plasma ovoid in shape and beaked or flagellate at either pole, measuring .004 mm. in diameter. These stain with Spiller.

"(*b*). Ordinary leucocytes.

"(*c*). Large irregularly globose leucocytes, mono- or poly-nuclear, in many cases containing the above beaked plasmodia (*a*), and frequently full of motile spores. These are evidently phagocytes.

"(*d*). Mulberry-shaped globose masses of yellow spores. These I have reason to believe are aggregations of spores in phagocyte cells, as they are more common when the animal is evidencing a resisting power against the disease, and may be observed in various stages of development.

"(*e*). Pigment granules solitary or in phagocyte cells.

"(*f*). Fusiform bodies .016 mm. in length, yellow, with white contents separated into two triangular segments, with the bases centrally placed, resembling the bodies figured by Golgi as one stage in the development of Laveran's parasites."

Ranking further says that the blood of ague conforms in pathological appearances with that of surra and an identical bacillus can be obtained.

ORGANS OF RESPIRATION.

Larynx.—The larynx usually presents nothing abnormal. (Lingard, 1893, p. 83.)

Trachea.—The trachea is sometimes the seat of congestion, and contains a quantity of frothy mucus. (Lingard, 1893, p. 83.)

Bronchi.—The bronchi are usually healthy, but occasionally present the signs of bronchitis, or contain purulent material when pneumonia is present. (Lingard, 1893, p. 83.)

Pleuræ.—The pleuræ rarely present signs of inflammation (case No. 8, however, showed signs of recent changes), but sometimes petechiæ are seen lying under the parietal pleura. The pleural cavity seldom contains any fluid, but in three cases several ounces were found in each. (Lingard, 1893, p. 83.) (See also "Serous effusions," p. 108.)

Lungs.—In one case Griffith Evans (1881, pp. 6–7) found the margin of one lobe of a lung hepatized. Steel (1886a, p. 171) records congested lungs. Lingard (1893, pp. 83–84) states that the most common morbid appearances in surra, according to frequency, are emphysema in nearly all ecchymoses lying under the visceral pleuræ, and a localized pneumonia is by no means uncommon. In one case bronchopneumonia was present, but in all the other twelve the lobules were surrounded by a gelatinous exudation, the change resembling pleuropneumonia of cattle. In a large majority of horses examined postmortem the lungs presented calcareous bodies situated rather superficially or in the depths of the tissues, exactly similar to those found in the liver. These are due to some cestode, and the changes are of earlier date, before the contraction or inoculation of surra.

According to the Veterinary Journal, London (1896, p. 181), the lungs are often emphysematous and sometimes the seat of local inflammation, while Hayes (1898, p. 481) says that the lungs often show signs of inflammation.

According to George H. Evans (1899, p. 38) the lungs are healthy as a general rule, but cases in which they are congested are by no means infrequent.

LYMPHATIC GLANDS.

The lymphatic glands throughout the body are more or less swollen and more or less edematous. (Burke, 1891, p. 270; 1897; p. 188.)

According to Lingard (1893, p. 82), the mesenteric glands are not enlarged as a rule, but abnormal appearances were noticed in one case.

ORGANS OF DIGESTION.

Mouth and tongue. (See p. 97.)

Pharynx and esophagus.—The pharynx and esophagus rarely present any abnormal appearance, but if any are present in the latter organ they are usually small wounds in the epithelium due to tne presence of *Gongylonema scutatum*.[a] (Lingard, 1893, p. 69.)

Peritoneum.—Symptoms of old circumscribed inflammation are visible in most cases as perihepatitis and occasionally perisplenitis, the organ being firmly attached to the stomach or to the parieties, but in no single instance has Lingard (1893, p. 82) observed any signs of a general peritonitis.

Mesenteric glands. (See "Lymphatic glands," p. 113.)

Stomach.—According to Steel (1886a, p. 170), gastric ulceration occurs in three-fourths of the cases, especially on the cuticular portion of the stomach; occasionally, also, the villous portion was affected. The ulceration in some cases extended to perforation. It was brought about by a peculiar yellow degeneration of the tissue, and is probably due to embolic plugging of the small blood vessels.

Burke (1888a, p. 5) states that gastric ulcers were frequently observed in the transport mules in the Burma outbreak, and, by way of comparison, he refers to the presence of similar lesions in chlorotic women. Such ulcers do not, however, appear to be present in all outbreaks. Later, Burke (1891, p. 270), in discussing ulcers, says that "the blood itself is rendered unfitted for the purposes of proper nutrition, and degenerative changes of an adipose character, sometimes leading to disintegration of portions of the imperfectly nourished tissue, take place. When organs and parts so weakened by starvation are distended with anemic blood which they can not utilize, sloughs result from gangrene of the imperfectly nourished tissues, as evidenced in the ulcerations of the stomach, etc., noted in this disease. The ulcer itself, once formed, suffers from nutritional defect, owing to the impoverished state of the blood, which prevents the formation of resisting tissue around it, and often leads to perforations."

Gunn states that the villous portion in these cases remained unaffected. In no case was ulceration to be seen, but the cuticular portion of the stomach was much thickened, and on the internal surface were observed numerous papillary eminences, each having a small and somewhat deep central depression.

Lingard (1893, p. 81), in referring to his own investigations, says:

> "In this investigation, in the majority of cases, the cuticular portion of the stomach has practically been found free from grave complications.
>
> "In 1 case the cuticular portion of the organ was described as thickened, but inexperience at that early period of the research probably led one to overlook the fact that the coats were merely contracted. A partial yellow coloration of the lining membranes, either only involving the left sac or in others staining both sides of the line of demarcation, was noted in 1 naturally acquired case of the disease and in 5 inoculated cases, and congestion of the cuticular portion was found once.
>
> "The villous portion of the right sac was much more frequently found to be the seat of marked changes.

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[a] This is a threadworm which burrows undulating tunnels in the epithelium of e esophagus. It is very common in cattle in the United States.

"Ulcers occurred in 2 cases and were probably due to the effects of parasites; congestion, only in 14—3 in naturally contracted cases, 9 in inoculated animals from horse to horse, and 2 through the goat.

"Petechiæ in 1 naturally acquired and in 3 inoculated. In 1 inoculated case extravasations of blood were present, and small, round, elevated white patches in 1 naturally contracted case. With regard to parasitical tumors, due to the presence of large numbers of the *Spiroptera megastoma*, they were present in 3 naturally acquired cases, whilst in inoculated cases from horse to horse they were observed in 23, and from goat to horse, etc., in 2; and in case No. 33, an extravasation of blood had occurred beneath the mucous and muscular coats."

George H. Evans (1899, pp. 37–38) in referring to surra says that—

"with regard to the postmortem appearances of this disease in Burma, one lesion is rarely if ever absent, namely, some change in the mucous membrane of the stomach, more especially of the cuticular coat, pigmentation, erosion, or ulceration. The positions in which these changes are most constantly met with are along the line of junction of the cuticular with the villous portion, and also at the lesser curvature. If an animal be destroyed during the early stages, discolored muddy yellow patches may be observed; if examined closely, one or all of them may present an eroded appearance. These changes are in most cases no doubt due to thickening and proliferation of the epithelium, which degenerates and breaks down, leaving the yellowish shallow ulcers. These, owing to the progressive degenerative changes, become deeper until, in many cases, perforation occurs. The ulcers may cover an extensive surface. I have seen some 6 or 7 cases in which from half to three-quarters of the cuticular coat was in an ulcerated state; and it was while making postmortems with another officer of the department that we came on two of the cases referred to, and in which no less than three-quarters of the cuticular surface was involved. The animals from which these stomachs were taken were destroyed, as they were suffering from surra. Neither was in bad condition, and both were taking food up to the very last moment. Though the cuticular coat is invariably involved, the lesions undoubtedly do in some cases extend to the villous portion. The anatomical differences, however, naturally, to some extent, alter the appearances of the ulcers, which are often seen with a smoother flat surface, and surrounded by a ring of swollen mucous membrane.

"I am of the opinion that in all cases of death from chronic surra, or in animals that have been destroyed after the disease has been in existence for some time, that ulceration of the stomach, more or less extensive, will be seen postmortem.

"The deep yellow pigmentation is not constant, but in nearly all cases there is a distinct yellowish tinge about the cuticular coat. The villous portion often is in parts, owing to degenerative changes, denuded of its epithelial lining. In some cases a large proportion of the cuticular coat may be pigmented. The color is a bright yellow, which shows up beautifully alongside of the whiteness of the normal epithelium. Parasites (*Spiroptera microstoma*) are constantly found, especially in the stomachs of mules, embedded in the gelatinous mucus of the villous coat, but, as you are well aware, have nothing to do with the disease. Bots are frequently met with, and this year I met with a case where the bots had attached themselves to the mucous membrane of the duodenum; there were quite 100. Spiroptera nests are sometimes seen in the stomach, I think more frequently in mules, but they are rare. Last month I was present at 41 postmortems, but did not observe a single nest. * * * "

Intestines.—In some cases there were petechiæ of the mucous lining of the intestines, similar to what was visible during life in the vagina and on the eyelids. The mucous membranes everywhere were more or less tinged yellow. (Griffith Evans, 1881, p. 7.)

In acute cases there is diffused congestion of the lining membrane of the bowels. In chronic cases there are small localized patches of congestion. (Steel, 1886a, pp. 170–171.)

Steel is quoted by Burke (1888a, p. 8) as authority for the statement that mucous congestions are continuous throughout the anterior two-thirds of the bowel, with presence of several worms. Burke (1897, p. 188) says that the alimentary mucous membrane is in an anemic condition with petechiæ and ulcerated spots [stomach?], the result of disintegration and atrophy.

In referring to the small intestine, Lingard (1893, pp. 81–82) states:

> "In a number of cases no pathological change of any kind is observable. On the other hand, it is by no means infrequent to find the mucous membrane between the duodenum and the cecum, more or less injected in patches, and ecchymoses dotted about either singly or in small groups. The solitary glands and Peyer's patches are never found enlarged or ulcerated, but the former present a pale color, whilst in the latter, the slightly pigmented condition of health. In those cases we have examined, the small number of entozoa present in the small intestines have been particularly noticeable, and especially has this been the case in Australians. Of the naturally acquired cases, 2 presented patches of congestion and 1 in those horses inoculated from the goat.
>
> "Ecchymoses were present in 2 naturally acquired, whilst no less than 9 inoculated, animals showed them."

George H. Evans (1899, p. 38) says that he has never observed ulceration of the small intestine, but he has noticed circumscribed local congestions. In a few cases, extensive mucous congestion was noticed. The intestines often contain a quantity of a very yellow fluid. There is nothing remarkable to note about the condition of the large intestine.

Liver.—According to Griffith Evans (1881, pp. 5–6), the structure of the liver was not diseased in any case, but in one instance the liver was studded throughout with calcareous degenerations of cestode larvæ. In two cases liver flukes were found with inspissated bile distending some of the bile ducts enormously.

Burke (1888a, p. 9; 1891, p. 271) refers to hepatitis, the early symptoms of which are shown by jaundice of the mucous membranes.

Lingard (1893, p. 82) states that the liver "is nearly always enlarged, especially so when death occurs during a paroxysm. In case No. 15 it weighed 19 pounds 17½ ounces. The anterior or convex surface, as a rule, presents circular patches, white or yellow in color, when the membranes have been yellow during life, and these are due to thickening of the capsule. The surfaces of both lobes in nearly all the cases observed have shown signs of old perihepatitis, and in a large majority of country-bred animals examined, small, round, or irregular masses of a hard, gritty consistency have been present on the surface of the organ, lying under the capsule and more or less invading the tissues; these are of parasitical origin.

"Perihepatitis was present in the organs of all the naturally acquired *surra* animals examined, and the hard concretions in Nos. 3, 10, 65, 70;

peribepatitis also was found in 16 inoculated horses and concretions in 13."

Nariman & Vaz (1893, p. 405) report that the liver is congested, enlarged, and, in some cases, calcareous. In one case the liver was simply a mass of stone from the aggregation of small calcareous particles, and weighed 49 pounds. The Veterinary Journal, London (1896, p. 177), refers to hepatic disturbances.

Hayes (1898, p. 481) refers to enlargement of the liver and spleen and petechiæ on various organs.

George H. Evans (1899, p. 38) says that the liver is usually healthy, but cases of congestion and softening may be met with. Miliary calcareous deposits are often seen, and in some cases the liver is much enlarged.

Pancreas.—The pancreas is normal. (Lingard, 1893, p. 82.)

Spleen.—Several authors refer to the enlargement of the spleen. Thus Lingard (1893, p. 82) says:

> "This organ is always enlarged to a greater or less degree, and, in some instances, has been found to assume abnormal proportions, especially in the case of an animal dying during a paroxysm, when the hematozoon has been swarming in the blood for some days. When, however, the animal succumbs and the organism has been absent for some time, it may be found to be little, if at all, enlarged. The capsule is generally dotted over thickly with irregular-shaped ecchymoses of a brick-red color, which are especially noticeable as they have a bluish-white colored or opalescent background.
>
> "The tissues as a rule, on sections, are firm to the touch and present a dark-red or purplish color.
>
> "This organ was found to be enlarged in 7 out of 9 naturally acquired cases, and in all petechiæ were present showing through the capsule. Of the inoculated cases, in 19 the spleen was enlarged, and in 18 out of 28 the petechiæ were marked."

Nariman & Vaz (1893, p. 405) say that the spleen is generally enlarged and hard, and George H. Evans (1899, p. 38) records that in advanced cases the spleen is generally enlarged. There is, as a rule, an excess of pulp, so that it pits upon pressure. The structure is at times disorganized.

According to Lingard (1895, p. 12), in the case of rats the weight of the spleen increases (from a minimum when the parasite is not present) in proportion to the number of hematozoa infecting the animal, and the maximum size of the spleen is reached toward the end of the rains. (See p. 158.)

URINARY SYSTEM.

Kidneys.—Griffith Evans (1881, p. 5) found the kidneys normal, except in one case, in which they were pale and sodden-like, but Burke (1888a, p. 3) refers to fatty degeneration of the kidney.

Steel (1886a, p. 171) refers to the kidneys as "congested or edematous." Lingard (1893, p. 84), in referring to the kidneys, says:

> "*The kidneys*, right—congested.
>
> '*The kidneys*, right—petechiæ. The organs generally present a pale appearance, but

> not unfrequently one or both are the seat of numerous petechiæ, in some instances so small as to be only the size of a pin's head, but may be much more extensive. They are scattered over the external cortical surface of the organs, and on section are found to dip into and invade the tissues below. The stellate veins are frequently injected, and occasionally the surface of the organ is the seat of congested patches."

The Veterinary Journal, London (1896, p. 181), records that the kidneys are often pale, flabby, and colored with petechiæ, and according to George H. Evans (1899, p. 38) they are frequently affected; at times anemic and edematous, at others slightly or markedly congested. In some cases he has observed considerable blood extravasation on and in the under parts of these organs.

Bladder.—There is little to note about the bladder. In some cases a patch of extravasation may be observed at the fundus or small petechial spots scattered over the mucous membrane.

MUSCLES.

The muscles of the back, especially in long-continued cases, are found to have undergone considerable atrophy. In the majority of cases they are of a very dark-red color, as if the animal had succumbed to asphyxia. When the case has been complicated by jaundice, all the tissues present a more or less yellow tinge. (Lingard, 1893, p. 80.) (See also "Emaciation," p. 94.)

CONNECTIVE TISSUE AND BONES.

In the majority of cases there is found a varying amount of a gelatinous, light yellow, or greenish colored material, lying in the subcutaneous tissues. This may occasionally be present in very large quantities, especially in the neck, lying on either side of the trachea, in front of the sternum and along the most dependent part of the abdomen, also involving the sheath and the extremities. It is also frequently found between the muscles and running along the sheath of the nerves; and in cases complicated with pneumonia the individual lobules of the lung are divided off or insulated by this jelly-like material. (Lingard, 1893, p. 80.)

The bones and the white tissues of the body generally are tinged yellow in jaundiced cases. (Lingard, 1893, p. 80.)

(See also "Edema," p. 92; "Fatty changes," p. 109; "Jaundice," p. 108.)

NERVOUS SYSTEM.

Steel (1886a, p. 171) reports edema of the brain and spinal cord. Lingard (1893, p. 84) describes the pathological lesions of the nervous system as follows:

> "*The cerebral membranes* in the majority of cases present a normal appearance, but in several cases increased injection has been noticed, and in one case the arachnoid presents signs of slight superficial extravasations.
>
> "An access of fluid in the lateral ventricles has been frequently met with. This

fluid is colorless or slightly opalescent, and in cases where the membranes have been yellow during life, the fluid may be tinged.

"The brain and cerebellum are pale, and the convolutions flattened when there is an excess of fluid in the lateral ventricles. The *iter a tertio*, etc., has been observed to be dilated, reminding one of the condition found postmortem in children who have succumbed to ventricular meningitis.

"*Spinal cord.*—In some cases there is an increase in the amount of fluid within the spinal canal, and in others a quantity of gelatinous material in the lower dorsal and lumbar region surrounding the cord, and this may in part account for the priapism in horses which occurs frequently in the course of the disease."

George H. Evans (1899, p. 38) states that he has never discovered extensive lesions in the nervous system. In a few instances the brain substance was undoubtedly soft and the plexus choroides was pale and bloodless. (See also p. 100, under "Action and paralysis.")

COMPLICATIONS OF SURRA.

Pneumonia.—When pneumonia was present, the consolidation was localized or circumscribed. In the majority of cases one lung only was attacked, but the lesions were not confined to any particular position, the apices, anterior inferior angles, bases, and center of the organs being the seat of the change; but in the latter position it was generally superficial, that is, lying directly under and for several inches below the pleura, which was also involved. It was observed in 3 out of 8 cases of the naturally contracted disease, and in 1 out of 2 cases when the disease was transmitted by gastric ingestion. But when transmitted by subcutaneous inoculation of antemortem and postmortem blood, with the former it was seen in 3 out of 19 cases, and with the latter in 6 out of 14 cases. (Lingard, 1893, p. 78.)

Emphysema.—A localized emphysema, usually complicating the apices and the edges of the lungs, was present in nearly every case in horses, but in guinea pigs it was found frequently pervading the entire organ. In several instances, distended lobules lying immediately beneath the pleuræ were found to project in the form of blebs as large as walnuts with very thin and almost transparent walls; while in one case the large bleb was filled with a clear but dark, amber-colored fluid, but not containing red-blood corpuscles.

A collapsed or atalectatic condition, more particularly of the apices, was not an infrequent complication. (Lingard, 1893, p. 78).

Nephritis.—According to Lingard (1899, p. 68), acute desquamative nephritis is a frequent complication of surra.

Pleurisy is an occasional complication. It was noticed in 3 cases; adhesions were present in 1 and with effusion in 2. (Lingard, 1893, p. 78.)

Sudden collapse has been mentioned by Steel as a not infrequent termination in surra cases in mules. In 2 cases Lingard (1893, p. 78) has observed it. In one case the animal fell dead without any premonitory symptoms or warnings of any kind.

Palpitations and vehement action of the heart occur to a greater or less extent toward the termination of every case. The impulse of the heart is so forcible as to move the body of the animal when each beat occurs. (Lingard, 1893, p. 78.)

Pericarditis has not been observed as a complication of surra. (Lingard, 1893, p. 78.)

Hemorrhages.—Lingard (1893, p. 78) observed epistaxis in 2 animals, but the hemorrhage on each occasion was only slight.

Miscarriage.—In small animals, such as rabbits and guinea pigs, pregnant females always miscarry within a short time after the appearance of the organism in the blood. If the female is near the full term of gestation when the organism makes its first appearance in the general circulation, the young may be born alive and thrive. (Lingard, 1893, p. 78.)

Edema of the extremities and undersurface of the abdomen.—In horses edema is of exceedingly common occurrence, and appears frequently as an early symptom. It first involves the fetlocks, more especially of the hind limbs, and gradually extends upward toward the hocks, the most noticeable features being the absence of heat and tenderness on pressure. In horses it is frequently accompanied by swelling and edema of the sheath and scrotum and at a later date spreads forward along the undersurface of the abdomen, finally invading the sternal region. In mares, after the extremities have become involved, small patches of semisolid edema are observed on one side or other of the chest or between the fore legs. As long as an animal is able to assume the recumbent position the exudation does not collect to any great extent, but as soon as the animal is condemned to the upright position for any length of time these accumulations increase, and may attain to considerable proportions. Arsenic when administered in full doses for some days appears to have a beneficial effect. The swelling and edema gradually become less and finally disappear completely. (Lingard, 1893, p. 79.)

Effusion in the joints.—This is sometimes met with, but is not of common occurrence. (Lingard, 1893, p. 79.)

CAUSE OF DEATH.

According to Steel (1886a, p. 169), some cases are acute and prove fatal after supervention of general dropsy, associated with local congestions. Probably the immediate cause of death in such cases is fever, for in his most acute case the animal, about an hour before death, gave the extraordinarily high temperature of 110° F. In chronic cases—that is, in about 96 per cent—death is brought about by gastric perforation, antemortem clot in the heart, or simply failure of the heart's action as a result of debility. The animals remain standing to the last, and suddenly fall dead or are recumbent or delirious for some days before the fatal result. Death is usually painless. (Griffith Evans, 1881, p. 3.)

CLINICAL DIAGNOSIS OF SURRA.

While certain symptoms, as already described (anemia, fever, petechiæ, ravenous appetite, extreme emaciation, high mortality, etc.), would naturally give rise to a suspicion of the presence of surra, microscopic examination of fresh blood to find the parasite is the most positive method of diagnosing the disease. In doubtful cases Lingard (1899, p. 60) injected the blood of suspects into guinea pigs and examined the blood of the latter daily. In the ordinary cases of surra, where no treatment has been adopted, the latent period, when guinea pigs are inoculated, is only about one week, but when the fluid for inoculation is taken from an animal that has been subjected to prolonged arsenical treatment the latent period is extended to about three weeks, and this time must elapse before the question can be decided.

> "The demonstration of the '*Trypanosoma Evansi*' in equines will distinguish surra from all other febrile diseases. As the periods of intermission in this disease vary in length from one to six days, so, in order positively to exclude the possibility of any cases presenting dubious symptoms being those of surra, it will be necessary carefully to examine microscopically the blood of the suspected animal daily for a period of 10 days. If the result of the blood examination should prove negative during the above-mentioned period, the case may then be safely declared not to be one of surra. It must be borne in mind, however, that a cursory examination of one cover-glass preparation of fresh blood on each occasion will often prove insufficient, for it happens in the course of a case that several days or occasionally a week may pass, during which period only one hematozoon may be discovered in two or even three cover-glass preparations. This most frequently occurs at the commencement or termination of a long paroxysm or in a case of chronic surra." (Lingard, 1893, p. 79.)

For a quick blood examination, it is recommended that a generous-sized blood drop be placed upon a cover slip. This slip is then placed, blood down, upon a slide, and gently pressed so that a blood ring forms around the cover glass. As this blood ring coagulates it seals the preparation. The parasites will be seen swimming with an eel-like motion among the corpuscles. They are about three to four times as long and one-eighth as thick as a white-blood corpuscle.

According to Griffith Evans (1881, p. 185), the parasites may be best observed in coagulated or defibrinated blood.

DIFFERENTIAL DIAGNOSIS.

According to Hayes (1898, p. 483), surra is often confounded with paralysis of the loins. Microscopic examination of the blood will give a positive diagnosis, while this and the chronic course of surra, together with the manner in which the internal temperature varies, distinguish surra from anthrax.

TREATMENT.

Nothing very encouraging can be said at this time on the subject of treatment. It is needless to lay stress upon the fact that a rapid destruction of the parasites is the point of greatest importance.

Salt and quinine are two of the most fatal substances for ordinary protozoa; osmic acid is also very fatal to them. We should be inclined to experiment along the line of hypodermic injections of quinine, salt, and arsenic in the hope of killing the hematozoa.

Griffith Evans (1881, pp. 184–185) has experimented with carbolic acid, but without success.

According to Ranking (1891, p. 403), the disease appears to be controlled by full doses of quinine, supplemented by general measures (chiefly milk, iron, and arsenic) to combat the anemia and weakness consequent on prolonged illness.

Nariman & Vaz (1893, p. 405) say that only two drugs are worthy of mention—inhalation of carbolic acid (1 oz.) in a closed room and the hypodermic injection of 2 grains of corrosive sublimate in a solution of common salt. When the former was used, the parasites disappeared from the blood in about 4 days, while after using the latter no parasites were detected after the second injection. In both cases, however, the animals died after lingering a few days longer. Iodine, iodide of potassium, quinine, and arsenic have failed to make any impression on the disease.

Burke (1897, p. 192) states that “though much has been said and written to the contrary, I hold, that provided prompt measures are adopted, and the disease is treated by quinine, arsenic, iron, and other tonics, by changing the water, and making some variation in the location of the animals, great benefit and even absolute removal of the disease may be secured.”

Pease (1897, p. 551) states that quinine in large doses will not control the disease. “One ounce of quinine given daily for 7 days failed to exercise any influence over the surra organism, and had far more effect on patient.” The attacks were invariably fatal.

Lingard has discussed treatment more than any other author. He selected the following drugs for experimental treatment:

> “*Mercuric chloride* has been employed subcutaneously, and also by direct injection into the circulation, with negative results.
>
> “*Iodine* and *iodide of potassium* by intertracheal injection, and also by subcutaneous inoculation, were followed by negative results.
>
> “*Iodoform*, by subcutaneous injection, and also by direct injection into the jugular, produced no good results.
>
> “*Oleum terebinthinæ*, by subcutaneous injection, and by injection into the jugular, was followed by negative results.
>
> “*Potasii bichromas* directly injected into the circulation, and by gastric ingestion, produced no marked effect upon the infusorian.
>
> “*Mixed cinchona alkaloids* and *arsenic* did not destroy the infusorian.
>
> “*Carbolic acid* and *iodine*, 76 drams of the former, and 34½ drams of the latter in 6 days, produced no apparent effect on the infusorian.
>
> “*Quinine*, in large doses, had no effect on the infusorian.
>
> “*Iodic hydrarg*, a very powerful antiseptic, had no effect.
>
> “*Santonin* had no effect.
>
> “*Potass* had no effect.” (Lingard, 1894c, p. 174.)

He reports his best success with arsenic, and he gives the following general directions (1899, pp. 68–69) for its use:

NOTES FOR GUIDANCE IN THE TREATMENT OF SURRA IN EQUINES.

"Only animals in good or in fairly good condition are suitable to undergo treatment for surra. It will be found impracticable to attempt to cure ill-preserved animals, such as Tonga ponies, toward the end of a heavy and hard-worked season.

"2. It is of the utmost importance for the successful treatment of surra that the disease be recognized, and the animal subjected to the drug with the least possible delay.

"3. The weight of the animal should be ascertained frequently when practicable, so that the maximum dose of arsenic to be administered during the treatment may be regulated.

"4. Arsenic should be given in the form of liquor arsenicalis (Fowler's solution):

	Grains.
Arsenious acid (in powder)	87
Carbonate of potassium	87

"Add half a pint of distilled water to these in a flask and heat till dissolved; cool, and add compound tincture of lavender[a] 5 drams, distilled water sufficient to make 1 pint.

"5. In most cases of surra in equines a dose of 5 grains may be commenced with and given twice daily for 48 hours, the quantity being increased by half a grain after every four doses have been administered, until 7 grains are reached. The latter amount should be continued twice daily for 7 days in the case of an animal below 800 pounds in weight; but in Australians of 1,000 pounds in weight and upward the dose may be increased by the addition of half a grain up to 9 or even 10 grains twice daily for the same period. The dose should then be gradually reduced by half a grain or 1 grain, according to the condition of the patient, until a 4-grain dose has been reached. Again, if possible, after a peroid of 2 days, repeat the treatment, increasing and decreasing the dose of arsenic as above described. But the fact must never be lost sight of, that, if arsenic be administered to an animal for a prolonged period, symptoms of gastric irritation will supervene sooner or later. It has been found that by giving *kaunji*[b] to the animal, morning and evening, directly after the medicine, the above-mentioned symptoms have not made their appearance; consequently, it would be advisable to give *kaunji* to the animals from the commencement of the arsenical treatment.

"6. Daily microscopic observations of the blood should be made, and the number of organisms recorded on a chart for ready reference, together with the temperature, pulse, and respirations of the patient, which should be taken three times daily, namely, 8 a. m., 1 p. m., and 5 p. m.

"7. Most animals will take the drug in one or two pints of water from a bucket without any trouble. If this be found occasionally impracticable, the arsenic can be mixed with the corn and bran in the form of liquor arsenicalis; but in obstinate cases the medicine will have to be administered to the animal in the form of a bolus or in a draught.

"8. Acute desquamative nephritis is a common complication of surra, but it must not contraindicate the administration of arsenic, although the maximum doses can not be maintained; otherwise the animal will have a relapse and ultimately succumb to the disease.

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[a] The compound tincture of lavender may be omitted, but the animals under treatment take the medicine more readily when it is present.

[b] Linseed, rice—ā ā one-half pound. Add water a sufficiency. Boil for three-fourths hour, and give when cool.

"9. Animals suffering from surra, as a general rule, have voracious appetites. It has been found by practical experience that the following amounts of hay, corn, etc., are necessary for an Australian horse weighing 1,000 pounds and over; for on this the animal keeps in fair condition and during convalescence puts on flesh rapidly:

Hay, 15 to 20 pounds	Daily.
Lucerne (fresh), 10 pounds	
Barley,[a] 8 to 14 pounds	
or	
Gram, 6 to 10 pounds	
Bran, 1½ to 3 pounds	
Salt, 1½ ounces	

"10. When once the organism of surra has vanished for some days from the circulation of the animal under treatment, gentle exercise, commencing with 500 yards and gradually increasing to 1 mile, morning and evening, may be allowed. But if the temperature becomes elevated, all exercise must be stopped until the former again registers within normal limits.

"11. The exudation of semisolid material (edema) into the subcutaneous tissues, notably that of the lower extremities, sheath, and undersurface of the abdomen, generally becomes absorbed after a time under the influence of arsenic and exercise, but this may be accelerated by daily massage of the body and limbs.

"12. Surra horses, under treatment with arsenic for long periods, and which eventually die, at their autopsies frequently present some atrophy of the spleen. Consequently, subcutaneous injections of infusion of spleens have been made in order to ascertain whether the material injected would perform the function of the atrophied organ. Encouraging results have been obtained.

"13. Certain of the horse-surra cases under treatment somewhat suddenly developed symptoms of chronic arsenical poisoning. These, which include partial loss of power over the hind quarters, crossing of the hind limbs when walking, and general unsteadiness and nervous tremors, usually proved fatal within 48 hours, although the further administration of the drug was immediately discontinued on their recognition. In some of the later cases under our treatment these fatal symptoms have been successfully combated by the subcutaneous injection of infusions of spleen and testicle (sheep).

"14. The question with regard to the administration of arsenic to animals at the commencement of the rains as a preventive in districts where surra is epizootic is one worthy of trial. A dose of 5 grains of arsenic in the form of liquor arsenicalis (10 drams) given once a day in the drinking water to each animal could not fail to produce a beneficial effect, and could with safety be continued for a month at a time. The dose of arsenic should then be gradually reduced every 3 days by half a grain at a time until it is discontinued altogether. An interval of 7 days should then be allowed to elapse and again the same process persevered in, with intervals, until the termination of the rains or end of October."

[The following important circular regarding treatment has recently been issued in the Philippines:

CIRCULAR, No. 4.
HEADQUARTERS DIVISION OF THE PHILIPPINES,
Manila, P. I., January 11, 1902.

The board ordered to inquire into and investigate a disease of animals called "surra" have found that Fowler's solution of arsenic given intravenously destroys parasites in nearly every case, and animals so treated are doing well; but such treatment is as yet not conclusive as to cure. Such treatment may be tried at all points where animals are infected.

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[a] Boil half the daily quantity given to the animal morning and evening with half the amount of salt for 1½ hours, then mix with the bran and give when nearly cold.

The board also reports that common house flies taken on sick animals have been found full of parasites, and it is therefore ordered:

That all abrasions or wounds be kept covered to prevent possibility of infection from this source.

By command of Major-General Chaffee:

W. P. HALL,
Assistant Adjutant-General.

Undoubtedly the intravenous injection of arsenic will be found much more satisfactory than Lingard's method. Regarding the flies, a confusion has taken place. The fly referred to is the stable fly (*Stomoxys calcitrans*), not the common house fly (*Musca domestica*). The latter species does not bite.]

PREVENTION OF SURRA.

A number of authors have urged the earliest possible removal of animals to camps or to healthier grounds as soon as surra breaks out. Several authors propose that greater care be exercised in regard to the food, water, and care of the animals. In discussing preventive measures, Pease (1897, pp. 561–562) makes the following interesting remarks:

"The methods of prevention suggested by Burke have been suggested years ago for other diseases, and have been consequently carried out as far as is practicable, and, I regret to say, are found to prove ineffective in regard to surra. If the animals remain in a surra zone, as in many cases they must do, the most minute precautions appear to be valueless. In this regard the following case may be quoted. The Naini Tal horse dâk line, running from Kathgodám to Naini Tal, have for years suffered great losses from the disease. In order to eliminate as far as possible every imaginable means of introducing the disease, the following precautions were taken:

"1. All the water given to the horses to drink was thoroughly boiled.

"2. No animal was allowed to drink water or graze anywhere outside. Muzzles were worn whilst they were at work.

"3. The hay upon which they were fed was especially collected, under European supervision, from the high mountains, at an elevation of from 5,000 to 6,000 feet, and carefully stacked.

"4. No green fodder of any kind was allowed.

"5. All grain was carefully hand-picked and screened before use.

"6. Thorough cleanliness and disinfection of the stables were maintained, and the animals were well protected from the weather.

"The management of these animals was perfect, the superintendent being a European of great experience.

"Result of the precautions: Every single horse belonging to the company perished from surra in the season (1896).

"In the same way the disease annually occurs in the Bombay tramway stables, a perfectly managed concern.

"This points to the conclusion that there is some other method of introduction in these cases, possibly flies, which we can not guard against."

Lingard's (1899, pp. 69–70) suggestions as to prevention are summarized as follows:

PREVENTION AND LEGISLATION.

"As it is recognized that surra may be propagated in animals by means of drinking water, fodder, rat excrement mixed with corn, and the bite of certain kinds of flies, the following rules for guidance were drawn up some years ago (1894), and owners of dâk animals in certain surra localities were informed of the best means of trying to protect their animals from acquiring the contagium. The following are the most important:

"1. All water for drinking purposes should be boiled, when possible, from [during the months of] June to October, inclusive, before being given to the animals at stations in districts infected with surra.

"2. Hay should be made in cold weather (October to January), and stacked for the use of animals during the rains. The hay is to be obtained from uplands, or from land not subjected to inundation, or, better still, from land entirely beyond the affected area. Green food should, during the rainy season, be prohibited, unless it is brought from without the surra area.

"3. All gram and corn to be screened and cleaned before being given as food.

"4. The use of the bel (creeper) leaves as food to be discontinued during the months of June to September, inclusive."

"Suggestions applicable to animals working on certain dâk lines where surra appears annually in the rains:

"1. Dâk animals, when returning to their own stage, should not be allowed to graze or drink water along the road, especially during the months of May to October, inclusive.

"2. A light preventive muzzle might be introduced.

"3. All diseased animals should at once be isolated at a considerable distance from healthy ones, and subsequently destroyed if not subjected to treatment.

"4. All carcasses should be burned, together with the dung and stable litter, where wood is available for the purpose; otherwise, deep holes should be dug and the bodies buried at a depth of 6 feet.

"5. Stables should be erected on high ground, and not, as so frequently happens, in a hollow bordering on the bed of a river.

"It is well known that surra, when untreated, is an absolutely fatal malady, the disease taking an unusually rapid course in the case of overworked animals. When once the disease is diagnosed the animal is useless. Isolation and subsequent destruction, therefore, would entail no hardship to owners; and power to enable officers to enforce it, and the burning of all diseased carcasses, would be a great step toward the limitation of outbreaks.

"The question of the introduction of an act to limit the spread of surra, as in the case of glanders, is an important one. It would be useless, however, to bring one class of animals (tonga ponies) under an act unless the other (ekka ponies) were likewise included; for at present the former only are under compulsory registration, although the latter are quite as numerous.

"No government official can interfere with animals the subjects of surra; consequently, only advice can be given to the owners as to the best means of prevention against the spread of the disease."

Some of these suggestions appear to be rather difficult of execution and others appear to us unnecessary.

Considering the present status of the subject, we would suggest the following points for consideration in the Philippines:

(1) As horses and mules are more severely affected than donkeys and cattle, it would be well to depend upon the former as little as possible. Transportation trains using donkeys and cattle will be less liable to destruction than those using horses and mules.

(2) Avoid the introduction of Australian horses.

(3) Avoid light-colored animals as much as possible; the darker the animal the safer he appears to be from the attacks of flies.

(4) Isolate infected animals and protect them from flies, especially if they have wounds or sores of any kind. A coating of tar and linseed oil or any similar substance over a cut will protect it from flies.

(5) Protect stock from flies in wet weather by use of smudges and by smearing. Among the various substances used for this purpose may be mentioned the following:

PREVENTIVES.

"Smudges had thus far proved the best method of protecting animals in the field against buffalo gnats. Thoughtful planters are in the habit of collecting and storing during the year all kinds of material that will produce a dense and stifling smoke; such materials are old leather, cast-off clothing, dried dung, etc. As soon as large swarms of gnats appear, and the stock is threatened by them, fires are started in different parts of the plantation, and are kept burning as long as the danger lasts. Anything that will produce smoke is thrown upon the smoldering logs, and the most offensive is considered the most useful. If the time for plowing has arrived, smudges are located in the fields in such a manner that the smoke is drifted by the wind over the teams at work. Such smoke-producing fires are also kept burning in the cities, and they are found in front of every livery and street-car stable, as well as of such stores as employ draft horses or mules. If these animals have to be upon the roads, they may usually be somewhat protected by tin pails in which some smudge is kept, and which are suspended from their necks and from the wagons.

"Animals may also be protected with a layer of mud or a coat of sirup. It has been found that animals which have shed their rough winter coat of hair and have become smooth are not as much troubled as others still covered with long hairs. The gnats find it much more difficult to obtain a foothold upon a smooth skin, and the clipping of the hair in early spring is therefore advisable.

"Buffalo gnats have a great aversion to entering dark places, and stables thoroughly darkened are safe places for stock of all kinds in a gnat season. The odor of ammonia prevailing in such stables may also to some extent prevent the insects from entering. Planters with a small acreage, therefore, prefer to keep their horses and mules in the stable instead of working them in the field. For the same reason the owners of livery stables will not allow their animals to be taken outside the city limits if gnats are numerous enough to be dangerous.

"But the great majority of planters can not wait for the disappearance of the pest, and have to resort to other defensive means. Various external applications have been used to this effect. Decoctions of alder leaves, tobacco, pennyroyal, and other herbs have been tried with a view of preventing gnats from biting mules while at work; but all of them have proven ineffective. At a time when small swarms of turkey gnats were tormenting mules plowing in the field one side of the animal was moistened by Mr. Lugger with various insecticides, while the other side was not protected at all. By following the animal and watching the gnats it was soon observed that any offensive smelling substance would drive the gnats from the protected side to the unprotected one. Kerosene emulsion, pyrethrum powder suspended in water, diluted carbon bisulphide, and dissolved tobacco soap were all used in turn, and all seemed to produce the same effect. Several times the whole animal was carefully sponged with the one or the other of the above substances. For a time the gnats would not settle upon the animal; but in the course of two hours the beneficial effect of these insecticides was gone and the insects were no longer kept away.

"Experience shows that the best preventive is grease of various kinds. The following kinds are the most important: Cotton-seed oil alone, or mixed with tar, fish oil, gnat oil; a combination of stinking oils alone, or mixed with tar or kerosene oil, crude coal oil, kerosene oil, kerosene oil mixed with axle grease, and others. To be effective, the grease must be used at least twice during the day, because as soon as its offensive odor disappears it becomes inoperative. All such applications are of no advantage, however, on stock running at large. Gnat oil is very extensively used, but it is, like the rest of the remedies, very apt to remove the hair. In fact, all these different kinds of oil and grease are more or less injurious to the animals, because a continued coating with them weakens the system.

"The employees of the Hudson Bay Company protect themselves and their stock against the bites of the "black fly" by the use of oil of tar, and, as long experience has shown, it to be a simple and easily applied wash, we strongly recommend its use. A quantity of coal tar is placed in the bottom of a large shallow receptacle of some sort, and a small quantity of oil of tar, or oil of turpentine, or any similar material, is stirred in. The receptacle is then filled with water, which is left standing for several days until well impregnated with the odor. The animals to be protected are then washed with this water as often as seems to be necessary.

"As long as stock in the infested region is suffered to run at large, and is neither provided with shelter nor food during the winter months, it will suffer severely from the gnats. Animals well cared for can stand the attacks of the gnats far better, and do not perish as readily. Illtreated and unhealthy mules and those bruised and cut are the first to die, and the prevailing opinion of intelligent planters is to the effect that well-cared-for mules, if greased twice a day when working in the field, seldom die even when attacked." (Osborn, 1896, pp. 36–37.)

Stordy (1899, p. 14) gives a figure of a pony in pajamas as a protection against tsetse fly.

(6) So far as possible, avoid camping in moist and marshy localities.

(7) So far as possible, prevent flies from breeding. Since many flies—and among these the biting stable fly (see p. 139)—breed in manure, the fly pest may be greatly lessened by a proper handling of the dung. The outside manure pile should be abolished, and every stable should have attached to it a well-screened dark closet in which the droppings can be collected. A small shovelful of chloride of lime scattered over the freshly collected manure every morning, together with keeping the manure in the dark and screened, will do much toward preventing the increase of flies.

HORSEFLIES (FAMILY TABANIDÆ).

In order to place interested persons in immediate possession of the more important points in regard to horseflies of the family Tabanidæ, the following account of these insects is quoted from Osborn (1896, pp. 58–71):

"The members of this family are large, some of them being among the largest of the order Diptera, and the females are provided with powerful mouth parts by means of which they inflict very painful bites upon cattle, horses, and other animals. Man does not escape, and as they are able to penetrate even thin clothing worn in summer, they sometimes become a source of annoyance to workmen in fields.

"The bodies are never very hairy, the head is large and composed almost entirely of the eyes, which during life are of brilliant colors and varied reflections. The antennæ are prominent and the third joint is composed of from three to eight minute rings, a character which, with the large eyes, distinguishes them at once from nearly all other large flies. The strong piercing mouth parts of the female are composed of six lancet-like organs, while in the male there are but four and these are not adapted to piercing the skin of animals. The males, and also the females, if not finding other food, feed upon the nectar of blossoms or the juices of plants, exuding sap from trees, etc.

"The flight of these flies is very strong and rapid and is attended with a buzzing, tormenting noise. The males may often be seen with the wings vibrating so rapidly that they become invisible, resting motionless in one place and then darting rapidly and resting suddenly again, generally turning the head in some other direction each time they dart. St. Fargeau has ascertained that this maneuvering is performed in order to intercept and seize the females. The power of vision is apparently in proportion to the size of the eyes. Dr. Williston says 'that they can see for a long distance seems certain. On the uninhabited plains east of the Rocky Mountains the writer has frequently seen them coming from a long distance, attracted by the sight of the horse on which he rode.'

"Such of the larvæ as are known are either aquatic or live in moist earth and are carnivorous, hence they may in some degree compensate for the bloodthirsty habits of the adult females. But notwithstanding the abundance of the insects, very little has been done toward determining the early stages of the species. More than a century ago De Geer described the larva of the common European species, *Tabanus bovinus*, and up to 1864 this was the only larva of the kind known. In that year Mr. Walsh described a tabanid larva (Proc. Bost. Soc. Nat. Hist., Vol. IX, pp. 302–306), but without obtaining the adult form. In 1869 Professor Riley bred the same kind of larva to the adult form and described the various stages (Second Rep. Mo. State Entom., pp. 128–132), the insect proving to be *Tabanus atratus* Fab., which is described further on.

"Dr. Williston says: 'The spindle-shaped brown or black eggs are found in spherical or flat groups, stuck together, and attached to the leaves or stems of grass and other plants; those of the aquatic larvæ are fastened to rushes. The larvæ are carnivorous; many live in the earth, others in water. They are predaceous, often upon snails and injurious insects, thus in a measure repaying the agriculturist for the molestation they cause him. The young larvæ are known to penetrate beetles or other larvæ and remain within them till they have completely consumed them, and their enlarged bodies have filled out the skins. Thus the larvæ of *Hæmatopota* have been observed feeding upon *Helops* and those of *Tabanus* upon Noctuæ.' (Stand. Nat. Hist., Vol. II, p. 417.)

"Quite recently Mr. C. A. Hart has made a notable contribution to our knowledge of this subject,[a] which will be drawn from in discussing the early stages of particular species.

"Authors generally agree that the after effects of the bites of these insects are less injurious than those of mosquitoes or buffalo gnats. The painfulness of the bite and the terror inspired by their presence is, however, a source of great torment to animals that are almost helpless in protecting themselves against them. The puncture they make is large, and after the proboscis is withdrawn there is not unfrequently an exudation of blood from the wound. This would tend to remove any poisonous injection, but since there is rarely any swelling or inflammation produced by these bites, it would appear that no poison is conveyed upon their piercing organs. Dr. Packard speaks of cattle and horses being 'occasionally killed by their repeated harassing bites,' and while this seems to be rather strong language, and we will refer to it again in considering *Tabanus lineola*, there is no question that the effects are serious enough, so that it is desirable to protect animals as far as possible from their bites.

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[a] Article VI, Vol. IV, Bull. Ill. State Lab. Nat. Hist.

"With horses in use the common practice of protecting with nets is the most effective method we know of, but for animals in pasture it would be particularly desirable to find some substance which could be rubbed over the hair, and, retaining its properties for a reasonable length of time, have sufficient repelling power to keep the flies away.

"The larvæ are not open to successful attack, and even if they were, the fact that most of them are probably beneficial should deter us from using destructive measures against them.

"They are widely distributed, and species occur in all parts of the world, torturing alike the elephant and lion of the tropics and the peaceful reindeer of the arctic region. It is during the hottest summer months that they are the most abundant, and they frequent both our timbered and prairie regions.

"The species are quite numerous, over 1,300 being known, of which about 150 are credited to North America. Manifestly it would be impossible in a work like this to even mention more than a few species, and, since so little is known of the early stages, there is no necessity for treating each species in detail. We will therefore in considering the species simply refer to the more common ones, the habits of which have been observed, and more particularly those occurring in this country.

"Osten Sacken's admirable 'Prodrome of a Monograph of the Tabanidæ of the United States' in Memoirs of the Boston Society of Natural History (Vol. II, Part IV, Nos. 1 and 4) will enable anyone to make a thorough study of our native species.

THE BLACK GAD FLY, OR BREEZE FLY.

(*Tabanus atratus* Fab.)

"Probably this is the largest species in the family, and it is certainly one of the most conspicuous, being quite common and of such a decided black color as to attract attention either on the wing or when perched on the back of some poor animal that tries in vain to drive it off. Fabricius described it in 1794 (Ent. Syst., Vol. IV, p. 366). Walsh described its larva in 1864 (Proc. Bost. Soc. Nat. Hist., Vol. IX, pp. 302–306), and in Riley's Second Missouri Report (p. 128) its life history is given except the egg and early larval stages. Its bite is one of the most severe of the tribe, but fortunately the species does not occur in such great numbers as the greenhead fly. Its attacks seem more commonly directed against cattle than horses, and it is most noticeable in sunny pastures, though occasionally seen perched on trees or the side of some building. The eggs are doubtless deposited in the vicinity of water, in moist places, but the exact details of oviposition are unknown.

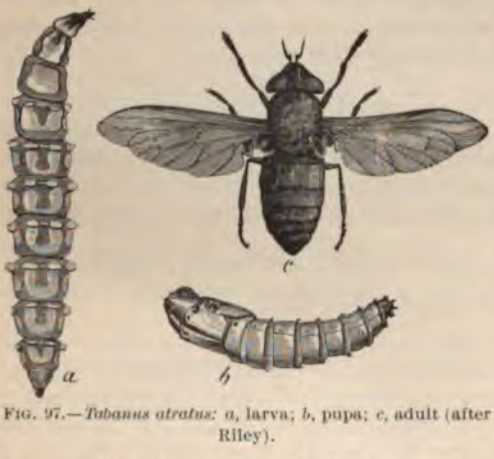


FIG. 97.—*Tabanus atratus*: *a*, larva; *b*, pupa; *c*, adult (after Riley).

"'The larva (fig. 97, *a*) is a large, twelve-jointed, cylindrical affair, tapering at each end, of a transparent, highly polished, glassy, yellowish, or greenish appearance, shaded with bluish green and furnished above and below, as in the figure, with large, roundish, sponge-like tubercles which are retracted or exserted at the will of the insect. Though the external integument is so transparent that the internal structure is readily visible, yet this integument is firm and the larva most vigorous and active, burrowing with great strength either backward or forward in the earth and between one's fingers when it is being held. Placed in water it will swim vigorously by suddenly curling round and lashing out its tail, but it is apparently not as much at home in this element as in the moist earth, for it is restless and remains near the surface with the tip of its tail elevated in the air. When the water is foul it moves about actively near the surface, but when it is fresh it remains more quietly at the bottom. The specimen which I succeeded in breeding was sent to me by Mr. Adolph Engelmann, of Shiloh, St. Clair County, Ill. It was found by Mr. William Cooper, of the same county, about 10 feet from a small but permanent body of water. Mr. Cooper at first took it to be a leech, and when he attempted to capture it it immediately commenced burrowing in the ground.'

"The larva reared by De Geer was terrestial. This larva is semiaquatic, for it is quite at home either in moist earth or water. My specimen was kept for over two weeks in a large earthen jar of moist earth well supplied with earthworms.

"It manifested no desire to come to the surface, but burrowed in every direction below. I found several pale, dead worms in this jar, though I can not say positively whether they had been killed and sucked by this larva. Mr. Walsh, in speaking of its haunts and its food, says:

"'I have, on many different occasions, found this larva among floating rejectamenta. On one occasion I found six or seven specimens in the interior of a floating log, so soft and rotten that it could be cut like cheese. Once I discovered a single specimen under a flat, submerged stone, in a little running brook. Finally, I once met with one alive, under a log, on a piece of dry land which had been submerged two or three weeks before, whence it appears that it can exist a long time out of water. I had on several previous occasions failed to breed this larva to maturity, and the only imago I have was obtained in 1861 from larvæ, which, suspecting them to be carnivorous from the very varied stations in which they had occurred, I had supplied with a number of fresh-water mollusks, but the habits of which, in consequence of having been away from home, I was unable to watch. On September 22, 1863, I found a nearly full-grown larva among floating rejectamenta, and between that date and December 23 he had devoured the mollusks of eleven univalves (genus *Planorbis*) from one-half to three-fourths of an inch in diameter; and on three separate occasions I have seen him work his way into the shell. In this operation his pseudopods were energetically employed, and I found, on cracking the shells after he had withdrawn, that a small portion of the tail end of the animal was left untouched—no doubt in consequence of his being unable to penetrate the small end of the whorl of the shell—and also the skin of the remaining part and the horny-tongued membrane.

"'My larva transformed to pupa within the ground during the fore part of July; it remained in this state but a few days and the fly issued July 13, and soon made its presence known by its loud buzzing inside the jar. It was a perfect specimen, and the pupal integument was sufficiently firm and polished, that by carefully washing off the earth an excellent cabinet specimen was obtained, which retained almost the exact form and appearance of a living pupa. Before the escape of the fly, which was effected through a longitudinal fissure on the back of the head and thorax, reminding one of the mode of escape of our harvest flies (Cicadæ), this pupa by means of the horns with which it is furnished had pushed itself up to the surface of the earth.'

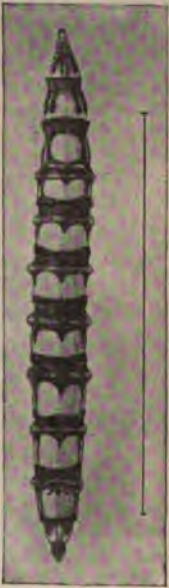


FIG. 98.—*Tabanus atratus*: larva (from Hart).

"The pupa (fig. 97, *b*) is nearly an inch and a quarter in length and a third of an inch in diameter. It is cylindrical, slightly curved, as in the figure, rounded at the head and tapering at the extreme hind portion. The abdominal segments are all but the first one provided with a ring of fine yellowish bristles, pointed backward. There is a stout thorn at the anal extremity, bearing six other thorns.

"The pupa state lasts but a few days and before the emergence of the fly it is pushed to the surface of the ground by means of the bristles and thorns of the abdomen, with bending movements of the body.

"It splits along the dorsal line and the fly emerges, leaving the pupa case in very perfect condition.

"The adult fly (fig. 97, *c*) is an inch or more in length, black throughout, the back of the abdomen covered with a bluish white bloom and the wings smoky black. They are common through the summer months and it is possible from the different times that full-grown larvæ have been observed that there is more than a single brood in a year. It seems probable, however, that the winter is spent in the larval stage and that the full-grown larvæ observed by Mr. Walsh in September were simply late specimens that had lived over the previous winter and would have pupated the same fall, producing the flies a few days later, and these have laid eggs to pass the succeeding winter. Hart says the larvæ were taken every month of the season except June, at which time they had mostly reached the pupa or imago stage.

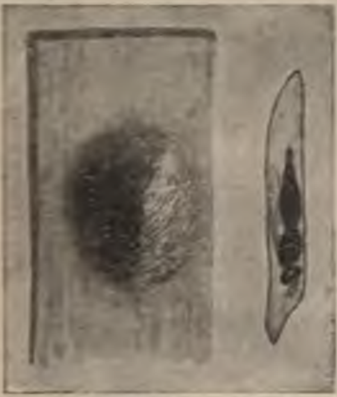


FIG. 99.—Egg mass *Tabanus atratus* and single egg containing parasite (from Hart).

"The habits of the adult have already been sufficiently stated, and as we have, unfortunately, no certain means of repelling them from cattle, so as to prevent the bites, which is the only thing we need fear from them, a discussion of remedies is unnecessary.

"It might be stated, however, that observations on the effect of tar and oil or other substances used to repel bot flies would be of value in arriving at some method of preventing their attacks.

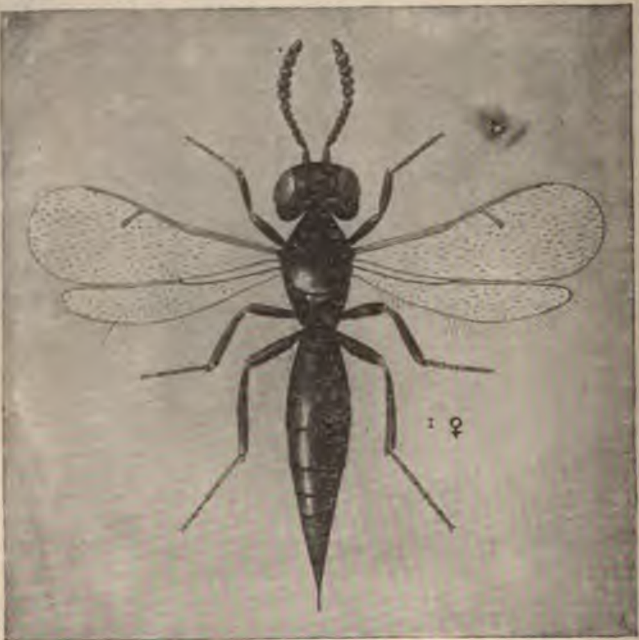


FIG. 100.—*Phanurus tabanivorus* Ashm. (from Hart).

"Hart records the rearing of parasites, *Phanurus tabanivorus* Ashm., from the egg masses of this species. Also the apparent parasitization of a larva.

GREENHEAD HORSEFLY.

(*Tabanus lineola* Fab.)

"This is generally regarded as the most common species in North America, and its occurrence in all parts of the country in large numbers fully supports such estimate.

"While it must have been a familiar pest to the early inhabitants of the country, its first scientific description was given by Fabricius. (Ent. Syst., Tom. IV, p. 369.)

"Packard (Guide to the Study of Insects, page 394), says:

"'This fly is our most common species, thousands of them appearing during the hottest part of the summer, when the sun is shining on our marshes and western prairies; horses and cattle are sometimes worried to death by their harassing bites. In cloudy weather they do not fly, and they perish on the cool, frosty nights of September.'

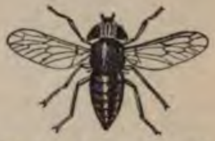


FIG. 101.—*Tabanus lineola* (from Packard's Guide)

"And also in Our Common Insects, page 74:

"'We were told during the last summer that a horse which stood fastened to a tree in a field near the marshes at Rowley, Mass., was bitten to death by these greenheads; and it is known that horses and cattle are occasionally killed by their repeated harassing bites.'

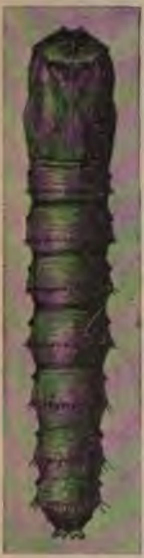


FIG. 102.—*Tabanus lineola*; pupa, dorsal view—enlarged (from Hart).

"This death of animals from bites must be very rare indeed, for in many years' residence in the Mississippi Valley, where the flies abound, the author has never known of such an incident, though the bites are certainly a great torment.

"The flies are brown, with a tinge of reddish, and the abdomen has a conspicuous whitish line along the middle. The eyes are a brilliant green, from which the name is derived.

"Hart has detailed the characters of the early stages as follows: 'The larva of this species closely resembles the young of *nigrescens*, and was not separated from it at first.' Examples of larvæ are said to have been collected in April and June, pupæ in May, and imagoes in May and June. 'The tabanid pupæ develop much more rapidly in hot weather than in cold, and to this fact is probably due the difference in time of emergence.'

"'Larva: Length, 20 mm.; diameter, 2.7 mm. Prothorax with lateral shining areas about as long as the dorsal area, striation about the same as that of the upper mesothoracic area; no noticeable central smooth spot; a small one on lower margin posteriorly; remaining lateral areas a little more finely and closely striate; dorsal and ventral areas of thorax nearly smooth on disk, with basal striæ; those on abdomen with moderately close striæ, more or less interrupted on disk; all areas more or less shining.

"'Surface whitish, dull pubescent markings very light brown but distinct, annuli narrow, crests of false feet also dull pubescent, their sides striate; lateral stripes of thorax distinct, slender, not dilated posteriorly, lateral edges of dorsal areas of thorax diverging; an opaque dark ring about the base of respiratory tube, and another encircling anal prominence, above it usually three light-brown spots.

"'Main internal tracheæ rather thick and noticeable, subparallel, not strongly sinuate, at least back of the middle. Terminal stigmatal spine often protruded.

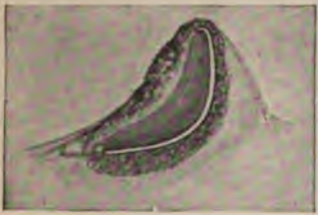
"'Pupa: Length, 19 mm.; diameter, 3 mm. Light ferruginous brown, shining, abdomen roughly wrinkled and subopaque. Palpal sheaths indistinct, not distant; tubercles not dark; ocellar tubercles indistinct or wanting; thoracic spiracular tubercles (fig. 103) slightly but nearly equally elevated, free margin rounded at tip, rima not vertical, evenly arcuate, slightly hooked in front.

"'Abdominal spiracular tubercles subtriangular, narrower behind, obliquely subconical, much shorter than basal diameter, bearing a small subcircular or short and strongly arcuate rima (fig. 104); on anterior slope a transverse groove, usually longer than the rima; fringes formed of unequal pale spines, only one or two long spines above on seventh segment; outer terminal teeth much longer than the others, directed laterally and upward, the tips of the four upper teeth about in line (fig. 105), fringe anterior to anal prominence showing a chitinous webbing between the bases of the spines, so that the separated tufts of the female look like a pair of broad, low teeth with several spiny points; lateral tufts low down, near ends of ventral fringe, formed of short spines.'—(Hart.)

"The species may be stated to have at least one natural enemy, for in the American Entomologist (Vol. II, p. 337) there is an account, by Mr. H. J. Dunlap, of their being eaten by the Nebraska bee killer (*Promachus bastardii* Macq.).

"This account is of considerable interest, and we quote it herewith:

"'*Champaign, Ill., August 6, 1870.*—I send you an insect by mail to-day in a glass bottle that has interested me for three or four years. I am hardly able to decide whether it is a friend or foe. My attention was first called to it by seeing several around my team during summer. Supposing them to be a new horsefly, I watched to see one bite, but was finally rewarded by seeing it pounce upon a greenhead (*Tabanus lineola* Fabr.). It settled upon my sleeve and soon had transferred the contents of Mr. Greenhead's body inside its own by sucking the juices out by means of its stout proboscis. I saw this operation repeated many times. The present summer I have seen them dozens of times, often five or six around my team, and have always noticed that in an hour or so after they appeared no more horseflies were to be found. I have also seen them 'sucking' house flies, lady bugs, chinch bugs, several moths, and have also seen them eat each other. The one sent you had just captured a honeybee, for which offense I made a martyr of him (or her) for the benefit of science.'



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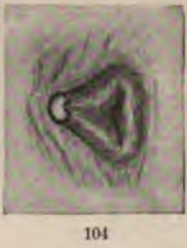

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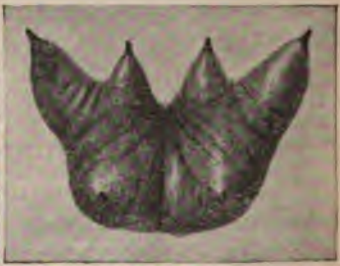

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FIG. 103.—*Tabanus lineola:* spiracular tubercle of pupa—enlarged (from Hart).
FIG. 104.—*Tabanus lineola:* abdominal spiracle of pupa (from Hart).
FIG. 105.—*Tabanus lineola:* end of last segment of pupa (from Hart).

THE GREENHEAD.

(*Tabanus costalis* Wied.)

"This is another common species very abundant in the prairie States, and was described many years ago. It is probably about as abundant and widely distributed as *lineola*, and causes a great amount of annoyance and suffering to domestic animals

"The following from Hart presents our present knowledge of the life history of the species:

"'This seems to be normally a terrestrial larva. We have taken it two or three times in the earth of cornfields in Champaign County. The dates given are May 31 and June 4. Examples were placed in a breeding cage and an imago of *costalis* was secured from them.

"'The imago, known as the 'greenhead,' is very generally common, and is quite a pest in some bottom-land prairies. A few examples were noted along shore at Station D, August 20. The examples in our collection were taken on twenty-two occasions, all between July 15 and August 13, except three dates, July 8 and August 18 and 31, which would make it probable that it is single brooded. The localities are Carroll, Lake, Cook, and Ford counties at the north, and Fulton, McLean, and Champaign counties in central Illinois. The specimens were from a variety of situations, usually in low herbage, often taken visiting flowers.

"'Larva: Length, 20 mm.; diameter, 2.7 mm.; prothorax with lateral shining areas about as long as the dorsal, coarsely striate, a smooth spot near center of disk; dorsal and ventral areas of thorax smooth, a few striæ on those of metathorax, especially posteriorly; remaining areas moderately striate, lateral areas of abdomen a little more finely striate than the others; all more or less shining.

"'Dark annuli pale, narrow, longitudinal stripes scarcely present; false feet with dull pubescent crests, their sides rather finely striate; a narrow dark annulus at base of respiratory tubes, another round base of last segment, inclosing anal prominence and giving off a pair of lateral stripes, the lower one longer; no projecting spines seen.

"'Pupa (from defective cast skin of male): Length, 20 mm.; diameter, 3 mm.; light fuscous brown, shining; abdomen smoothly wrinkled; slightly opaque; prothoracic spiracular tubercles slightly but nearly equally elevated, free margin rounded at tip, rima not vertical, evenly arcuate, slightly hooked in front.

"'Abdominal spiracular tubercles small, subtriangular, narrower behind, obliquely subconical, much shorter than basal diameter, bearing a very small subcircular ring; fringes formed of unequal pale spines, the longer ones sparse on seventh segment above; outer terminal teeth twice as large as lower pair, directed laterally and slightly backward; upper pair smallest, directed upward; ventral fringe of last segment not noticeably webbed; lateral tufts rather high, not near ends of ventral fringe.

"'My material of this species is not in best condition for accurate comparisons.'

Tabanus annulatus Say.

"This species was described by Say in 1822 (Jour. Acad. Phil., Vol. III, p. 31; Comp. Writ., Vol. II, p. 53), and its territory stated as Missouri.

"It does not seem to have received special notice since.

"It is probably not abundant enough to cause serious annoyance to stock or is commonly confused with some more common species and has consequently received little attention.

"It is smaller than *Tabanus lineola*, the length of the body being a little more than two-fifths of an inch.

"It is of a leaden-gray color tinged with reddish; the abdomen blackish brown with gray margins to the segments, the wings without spots and slightly dusky. (From Say's description.)

Tabanus stygius Say.

"This species is almost as large as *Tabanus atratus* Fab., nine-tenths of an inch in length, and occurs in the Mississippi Valley. Say's description in 1822 (Jour. Acad. Nat. Sci. Phil., p. 33) locates it in Arkansas.

"It is violet black and with the thorax pale chestnut. The front of the head is yellowish, the thorax with five gray lines, the wings rusty with three brown spots. (From description of Say.)

"It is fairly common at Ames, Iowa, but has not been observed as especially annoying to stock. It has a wide range, however, and deserves to be studied with reference to its early stages.

"Hart gives the following facts concerning the species, with descriptions of early stages:

"'The present species was the most abundant tabanid larva in the vicinity of Havana last spring (1895). It first appeared in our collections September 14, when a number were noted swimming amidst vegetation near the margin at Station B. In the spring they were found at nearly all of the stations, but more particularly in connection with tipulid, muscid, and Eristalis larvæ, in matted accumulations of dead stems and leaves over mud. They were especially abundant March 30 in Flag Lake, where large plump larvæ appeared at every turn. It was a surprise to find a few of them upon the bottom in open, shallow water, far from shore, in the middle of Quiver Lake at Station A. Young larvæ have been common in connection with larvæ of

Bittacomorpha and *Limnophila* at Station I since March 17. At Stations B and G they have been common in moist drifts of fine rubbish washed up by waves. Pupæ were found in the breeding cages May 10 and 23. One emerged May 27 and another tried to emerge June 2, but died and was removed from its case.

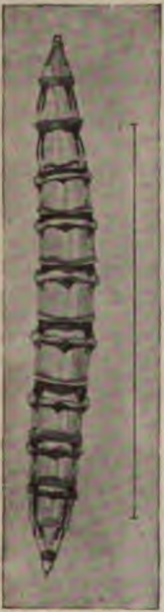

FIG. 106.—*Tabanus stygius*: larva (after Hart).

"'The larvæ resemble those of the *lineola* group in their striation and coloration, but differ in their short lateral prothoracic areas and larger size. They are like *atratus* in size, but may be readily separated from it by their coarser lateral striation, straw-yellow tint, slender lateral vittæ, and usually projecting terminal stigmatal spine.

"'Larva: Length, 45–55 mm.; diameter, 6–7 mm.; bright straw yellow, varying in some young larvæ to nearly clear white, marked with light fuscous brown microscopic pubescence, usually paler at each stage than *atratus*.

"'Lateral prothoracic striated areas not more than half as long as the dorsal, striation not finer than that of the middle and lower lateral areas of the mesothorax, striated portion shining; a small smooth spot adjoining the impressed line below; remaining upper thoracic areas a little less closely striated, but not strongly different from that of the prothorax; abdominal lateral areas a little more finely striate; dorsal and ventral areas with margin striated, disks nearly smooth in adult larvæ, last segment more strongly striate, especially beneath.

"'Dark annuli distinct, broad, including false feet, a distinct, transverse dorsal and ventral pale spot in front of the false feet; abdominal annuli often with a small triangular backward prolongation on median line above. Prothoracic lateral space occupied by a pale brownish fuscous quadrate spot in front of the striated space. Meso- and meta-thoracic lateral stripes usually distinct, but slender, scarcely dilated posteriorly, lateral edges of dorsal areas diverging; lateral stripes above the abdomen almost wanting, except on last two segments. In these stripes the punctures of the upper and lower rows are indicated by rounded pale dots, and those of the inner rows by elongate dots. Last segment with bases of respiratory tube and anal prominence encircled with dark rings, joined by a lateral connection, its dorsum with at most a short basal line or pair of dots on each side. Coarser pubescence of false feet tipped with pale brownish.

"'Main internal tracheæ thick and noticeable, especially in young larvæ, lustrous, subparallel, not strongly sinuate, nearly straight posteriorly; terminal stigmatal spine dark reddish brown, smooth, usually protruded (fig. 107, p. 136).

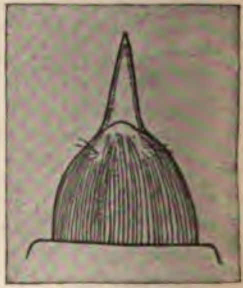

FIG. 107.—*Tabanus stygius*: last segment of larva, side view, showing projecting spine—enlarged (from Hart).

"'Pupa ♀: Length about 30 mm.; diameter about 6 mm.; light brownish fuscous, thorax paler, shining; abdomen roughly transversely wrinkled and subopaque. Palpal sheaths distinct, as far apart as are the setæ borne by the larger tubercles at the center of the anterior surface of the head; surface between them rounded, bearing a small wrinkled tubercle at middle; antennæ and tubercles darker than surrounding surface; ocellar tubercles distinct; prothoracic spiracular tubercles slightly but evenly elevated in a plane parallel with that of the surrounding surface; rima nearly straight in its outer half, inwardly curving strongly forward and ending in a conspicuous hook; free margin of tubercles rounded at tip.

"'First abdominal with two distinct setæ each side above the spiracles; abdominal spiracular tubercles rounded, broad behind, low, subhemispherical, rima long, following posterior border of tubercle, slightly curved at middle, more strongly curved forward at each end; on anterior surface a transverse groove extending across the tubercle, but not as long as the rima. Fringes of unequal spines, often tipped with blackish, all but two of the long spines wanting in a broad space above on seventh segment. Terminal teeth nearly equal, tipped with blackish, their points marking the angles of a hexagon, slightly wider than high. Ventral fringe of last segment not webbed together; lateral tufts high, on a level with upper lateral line.'

Tabanus molestus Say.

"In describing this species in 1822 (Jour. Acad. Phil., Vol. III, p. 31; Comp. Writ., Vol. II, p. 53) Thomas Say states:

"'This is one of the species that are called prairie flies. It is numerous in the prairies of the State of Missouri and is very troublesome to the cattle. I have seen cattle in the forests which margin these prairies when attacked by these insects start suddenly and plunge into the thickets that the branches may divest them of their enemies. Travelers are much incommoded by them; many cover their horses with canvas, etc., to shield them from their attacks, or rest in some shaded or secluded situation during that part of the day when they are the most abundant.'

"No special mention is made of it in subsequent works, but we know it to be fairly common in the Mississippi Valley. Say's account probably covers territory outside of the present State of Missouri; and Wiedemann (vide O. S. Cat., p. 22) is authority for its occurrence in Kentucky.

"It is a rather large species, nearly four-fifths of an inch long; the thorax gray, with brown lines; the abdomen black-brown with a gray central stripe, which is widened on the middle segments and consists of triangular spots on the fourth, fifth, and sixth segments.

EUROPEAN GADFLY.

(*Tabanus bovinus* Linn.)

"From the statements of European writers this is apparently *the* gadfly of Europe, or at least the one which is particularly troublesome to cattle.

"According to Linnæus (Syst. Nat., Turton Transl., Vol. III, p. 67), it inhabits Europe, and is extremely troublesome to cattle.

"The eyes are greenish; back of abdomen with white triangular longitudinal spots.

"The early stages of this species were traced by De Geer (Mem. Ins.), who found the larva to be terrestrial and carnivorous. His observations on this species were the first giving information upon the early habits of the Tabanidæ.

THE BANDED BREEZE FLY.

(*Therioplectes cinctus* Fab.)

"The banded breeze fly, or orange-belted horsefly, is a species of somewhat larger size than the greenhead. It is rather less abundant than the black breeze fly, which it somewhat resembles, excepting the orange or reddish band on the abdomen. It is limited more to the Eastern States. It was described by Fabricius at the same time as *Tabanus atratus* (Ent. Syst., Vol. IV, p. 366).

Hæmatopota pluvialis Linn.

"According to Kollar this is one of the most troublesome species. He says:

"'It is not much larger than the common horsefly, and is chiefly distinguished by its large green eyes, through each of which run four brown undulating bands.

"'The body is gray with brownish cross stripes; the wings gray with brown spots. It frequents meadows and pastures and attacks horses and horned cattle in sultry weather before rain, nor does man escape. Although the wound it inflicts is sharp, it does not produce any lasting itching or burning.'

"This statement regarding the injury caused does not agree entirely with the statements of other authorities, for in Kirby and Spence's Entomology (p. 93) we find a quotation from MacLeay which reads as follows:

"'I went down the other day to the country, and was fairly driven out of it by the *Hæmatopota pluvialis*, which attacked me with such fury that, although at last I did not venture beyond the door without a veil, my face and hands were swollen to that degree as to be scarcely yet recovered from the effects of their venom. I was obliged on my return to town to stay two days at home. Whenever this insect bites me it has this effect, and I have never been able to discover any remedy for the torture it puts me to.'

"Also, in Linnæus under the description of the species:

"'Like *T. cæcutiens*, this little insect fixes on the hands, face, and legs, exciting a painful inflammation in the part where it has drawn blood.'

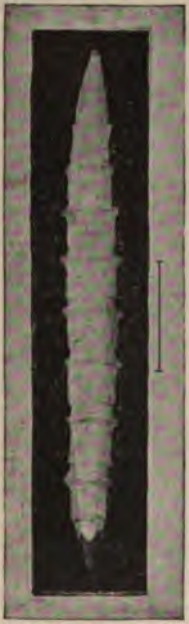

FIG. 108.—*Chrysops vittatus:* larva (after Hart).

THE EAR FLY.

(*Chrysops vittatus* Wied.)

"This is a rather small species, yellow in color, with black stripes and a broad, smoky band across the middle of each wing. It was described in 1821 by Wiedemann, but without reference to its habits.

"It is said to be very troublesome in the wooded regions of the Mississippi Valley, directing its attacks particularly upon horses' ears, in consequence of which it is commonly called the 'ear fly.'

Chrysops univittatus Macq.

"This is a common species in the prairie region and is recorded from District of Columbia, Maryland, Connecticut, New Jersey, and Kentucky by Osten Sacken. It appears to be the most common species at Ames, Iowa.

Chrysops niger Macq.

"A similar species, black in color; also very common.

Chrysops quadrivittatus Say.

"Say described this species in 1822 as inhabiting the region near the Rocky Mountains. It is of a gray color, with four longitudinal brown lines on the thorax. The wings have a large brown spot on the front margin. It is nearly two-fifths of an inch in length.

Chrysops costatus Fab.

"Occurs in South America and the West Indies.

Chrysops fugax O. S.

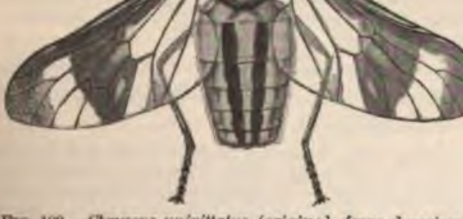

FIG. 109.—*Chrysops univittatus* (original, from drawing by Miss L. Sullivan).

"This species, easily recognized from the figure, is widely distributed. Osten Sacken recorded it from Maine, New Hampshire, Canada, Idaho, Montana, and Yukon River. It occurs at Ames, Iowa, and doubtless throughout the northern Mississippi Valley at least.

THE HIPPOBOSCID-LIKE TABANID.

(*Goniops hippoboscoides* Aldrich.)

"Under the above name Mr. J. M. Aldrich has described a very peculiar fly, that has the structure of the tabanids, but the general appearance of a hippoboscid, although it is not known but only surmised that it may have a parasitic or semiparasitic habit.

"Since nothing is known as to the habits or the early stages of the species, and it would seem to be of very rare occurrence, it will suffice for the purpose of this paper simply to refer to the original description and figures (Psyche, Vol. VI pp. 236, 237)."

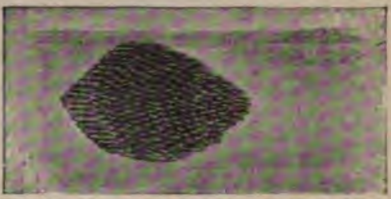

FIG. 110.—Egg mass of *Chrysops æstuans* (from Hart).

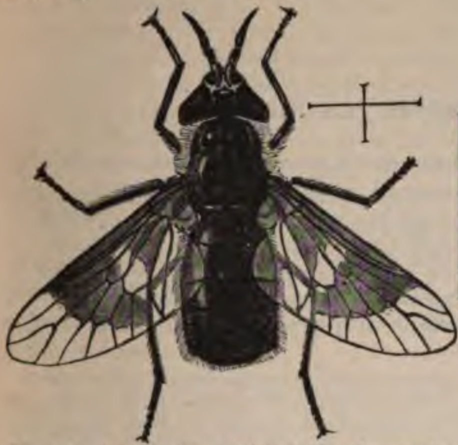

FIG. 111.—*Chrysops fugax* (original, from drawing by Miss L. Sullivan).

THE STABLE FLY (STOMOXYS CALCITRANS).

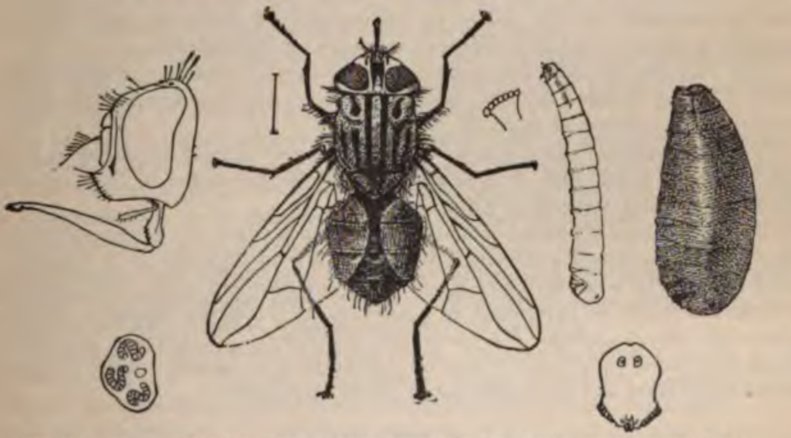

FIG. 112.—*Stomoxys calcitrans:* Adult, larva, puparium, and details—enlarged (original).

[Dr. Curry's observations mentioned on page 79 make it advisable to add a few words regarding the biting stable fly (*Stomoxys calcitrans*). This insect is somewhat similar to the common house fly (*Musca domestica*), for which it is frequently mistaken. Despite its name, it is not confined to stables, but frequents also groves and even houses, sometimes biting man and causing considerable annoyance. It is, in fact, this insect which has given rise to the popular idea that flies bite before a rain. It breeds in dung, so that a proper disposition of the manure, as suggested on page 128, will prevent its undue increase. This fly is very common, and has a wide geographical distribution.]

NAGANA, OR TSETSE-FLY DISEASE.

In connection with surra it will be of interest to the reader to be able to compare some of the recent results obtained from the study of nagana, or tsetse fly disease. To supply the necessary data we append here an account of the investigations recently published by Kanthack, Durham & Blandford (1898a, pp. 100–118). The report is reprinted in full, as it is not generally accessible to physicians and veterinarians here and in the Philippines.

"On nagana, or tsetse fly disease. (Report made to the Tsetse Fly Committee of the Royal Society of Observations and Experiments, carried out from November, 1896, to August, 1898.) By A. A. Kanthack, H. E. Durham, and W. F. H. Blandford.

"At the request of the Colonial Office, the Royal Society of London appointed a committee to cooperate with Surgeon-Major Bruce in his research upon nagana, or the tsetse fly disease. This committee intrusted us with the actual experimental work. The object was to study nagana systematically in ordinary laboratory animals, to investigate the life history of the hematozoon discovered by Bruce, and, if possible, to discover methods of prevention, cure, or immunization.

"The material for our observations was obtained in the first instance from the blood of a dog infected by the disease on the voyage from Africa, and brought to England in November, 1896, by Dr. Waghorn.

"The investigation was begun at once at the pathological laboratory of St. Bartholomew's Hospital, but in February, 1897, was transferred to the pathological laboratory of the University of Cambridge.

"*The Hematozoon* of nagana has already been described by Bruce, and is closely allied to the *Trypanosoma* of surra. We have had no opportunity of studying the latter disease, the relation of which to nagana is referred to later. The parasite discovered and described by Rouget[*] in a horse in Algeria is also similar. In English sewer rats (*Mus decumanus*) a *Trypanosoma* (*T. sanguinis* [*T. Lewisi*]) is occasionally found, but this is quite distinct from the hematozoon of nagana, both in its morphological appearance and in its pathogenic effects (*vide infra*).

I. Susceptibility.

"Cats, dogs, mice, rabbits, rats, both sewer rats (*Mus decumanus*) and white and piebald rats (*Mus rattus*), are highly susceptible, and in these animals the disease has proved fatal in every case of infection which has been allowed to run to a close.

"A single *hedgehog* inoculated was readily infected and died in 17 days, so that this animal probably possesses a high susceptibility.

"A single *donkey* was inoculated and was killed 12 weeks later, being then in a weak condition and near dying.

"Two *horses* have been inoculated, one a strong and well-fed cart horse (Russian), which survived 7 weeks, the other a rather old animal (see under zebra hybrids), which survived only 8 days.

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[*] Annales de l'Institut Pasteur, 1896, p. 716.

"A *bosch-bok* has also been inoculated; it died 7 months afterwards without showing any lesions. All the inoculations made from it proved negative.

"Two hybrids of zebra and horse (♂ zebra and ♀ horse, and ♂ horse and ♀ zebra) and one hybrid of zebra and ass (ass ♂ and ♀ zebra) have also been inoculated. These were kindly put at the disposal of the Royal Society by Prof. Cossar Ewart, of Edinburg, in order to see whether such hybrids are refractory to nagana.

"The two former were infected by plunging a needle wetted with nagana blood beneath the skin; the latter received a dose of 1 c. c. of the same blood. All of them died in about 8 weeks. During the course of the disease they showed irregular rises of temperature, sometimes up to 41.6° C. Variations in the number of hematozoa were ascertained in the case of the horse hybrids; on some occasions they were abundant (66,000 per c. m.). Whenever the donkey hybrid was examined at the earlier stage of the illness, the hematozoa were found to be either scanty or absent. A horse which was inoculated as a control died in 8 days, with very abundant hematozoa in its blood; this animal must have been peculiarly susceptible to nagana, as no other cause for death could be found at postmortem examination. There is no reason for supposing that the hybrids exhibited any more refractoriness than other horses or asses.

"Koch[a] reports on attempts which he made to infect two Masai donkeys, and two crosses from Muscat and Masai donkeys. None of these showed any symptoms of the disease up to 3½ months, nor were hematozoa discovered in their blood at any time, although repeated examinations were made. Consequently there is no proof that these animals were really infected. In our experience scratch inoculations sometimes, though rarely, fail; on the other hand, inoculations by puncture with a needle or by actual injection do not fail; Koch's animals were inoculated by the scratch method. It should be added that all his control infections were successful. He did not find that ordinary mules showed any immunity.

"With regard to *guinea pigs*, at first we thought that they were refractory under normal conditions, and that it was possible to infect them only after their resistance had been reduced by bleeding or other interferences.

"We found, however, that guinea pigs are susceptible to nagana under ordinary conditions, but that, as a rule, the disease in them is more protracted than in rabbits, rats, mice, cats or dogs, and even horses; so that they are distinctly more resistant than these animals. In no instance, however, has recovery ensued after hematozoa have once appeared in the blood.

"According to unpublished observations by Bruce upon the tsetse fly disease in South Africa, it appears that native *goats* and *sheep* are to some extent refractory, the disease, as a rule, running a chronic course (five months).

"A *monkey* (*Macacus rhesus*) was also tried. It died in about 2 weeks in an advanced condition of pulmonary tuberculosis, but the presence of abundant hematozoa had been determined in the blood during life up to the time of death.

"A *weasel* was injected. It showed hematozoa in its blood, and died a few days later, but death almost certainly was hastened by the effects of captivity.

"Pigeons are the only *birds* which have yet been tried. The pigeons after inoculation did not show signs of the disease, nor was their blood infective. It may be mentioned that Bruce tried South African *hens* without success. Further experiments with birds are in hand.

"*Young animals*, if susceptible (kittens and puppies), as a rule, have died earlier than adults, and while suckling they are still more highly predisposed; young guinea pigs, however, are comparable to older ones in their resistance.

"The *fetus in utero* of infected rabbits, guinea pigs, or rats is not infected, although the mother's blood may contain a large number of hematozoa. The latter are to be found in the placenta, but not in the fetal blood. Similar observations have also been made by Lewis,[a] Lingard,[b] and Rouget[c] in their investigations on allied hematozoa.

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[a] Reiseberichte [1898a], pp. 69 and 88.

II. Duration of disease in the different animals.

"As will be seen from the figures given below, the lethal period varies somewhat in each species of susceptible animal. The duration of the disease appears to depend principally upon the individual susceptibility rather than on the mode of inoculation or the quantity of infective material introduced. Thus, of 4 rabbits inoculated in the same manner with the same material, 3 died on the twelfth, twenty-first, and twenty-fourth days, respectively, while the fourth was killed on the forty-first day; many similar instances could be cited. Nor does a larger quantity necessarily determine a more rapid death; thus, a rabbit which has received the whole blood of another rabbit containing numerous hematozoa may survive longer than the minimal lethal period for rabbits. We have not been able to define the conditions which determine these variations in susceptibility. Rouget has noted similar variations in the lethal period.

"The ratio of the minimal to the maximal lethal periods is about 1 to 5 or 1 to 6 in rabbits and rats, and 1 to 9 in guinea pigs. The number of other animals inoculated has not been sufficiently great to determine a satisfactory ratio.

"In our experiments dogs survived an infection 14 to 26 days, cats 22 to 26 days, rats 6 to 26 days, mice 8 to 25 days, rabbits 13 to 58 days, and guinea pigs 20 to 183 days; the average duration being for dogs 18 days, for cats 24 days, for rats 12 days, for mice 13 days, for rabbits 30 days, and for guinea pigs 50 days.

"Since the commencement of these experiments a large number of animals have been dealt with, and thus an extensive series of cross inoculations has been carried out; but we have found that the duration of the disease is not dependent on the kind of animal from which the hematozoa are derived. No constant modification is therefore effected by passages, either in the direction of attenuation or of increased virulence. This statement is completely borne out by Bruce's observations on wild animals, as well as African sheep and goats, for he found that the hematozoa of these animals were as infective as those obtained from highly susceptible animals, such as dogs.

III. Mode of inoculation.

"Inoculations have been made with the blood of an infected animal subcutaneously, intravenously, or intraperitoneally, or by applying a minute and often minimal quantity of infected blood to a superficial scratch. Rabbits have also been inoculated in the anterior chamber of the eye; and rats directly into a lymphatic gland.

"Blood taken from diseased animals, although showing no hematozoa when examined microscopically, has frequently been proved to be fully infective, so that it appears that a single hematozoon or at any rate a very small number of them, successfully introduced, are capable of producing the disease. At present no method of graduating the dose appears possible, since a minute quantity is as effective as much larger quantities, though the lethal period may be somewhat prolonged. It is also possible that unrecognized forms are present in these cases, though it should be added that in some instances where no hematozoa are found in simple films we were able to detect them by means of centrifugalizing the blood.

"Successful inoculations have also been made with lymphatic gland, spleen, bone marrow, aqueous humor, serous fluid, edema transudation, and testicular juice.

"The incubation period and the duration of the disease, as already pointed out, are not entirely dependent upon the number of hematozoa in the material injected, or the source of the infective material. Thus, the hematozoa of lymphatic glands, etc., are as infective as those of the blood. The duration of the disease is not materially affected by the mode of inoculation adopted, and is about the same whether the infection was brought about by subcutaneous, intravenous, or intraperitoneal injection, or by a superficial scratch.

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[a] Physiol. and Pathol. Researches [1888], p. 630.

[b] Summary of Further Report on Surra, 1895 [p. 12].

[c] Annales de l'Institut Pasteur, 1896, p. 716.

"Material taken from the bodies of animals twenty-four hours or sometimes less after death is hardly ever infective, even when several cubic centimeters are injected, so that we have no evidence of a resisting or sporing form which survives in the tissues or blood of the dead animal and is inoculable into other mammals. It must be added that putrefactive changes often set in with great rapidity in the bodies of animals dead of nagana.

"Blood drawn from the living infected animal and kept *in vitro* in an aseptic condition retains its infective power *at most* for 3 or 4 days, but this period is generally less. Complete drying also renders blood noninfective.

"Blood heated to 50° for 30 minutes invariably becomes noninfective, even in large doses (such as 4 c. c.), while, when heated to 46° C. for half an hour, it proved infective in one out of two cases, although apparently the hematozoa had become nonmotile—at least no motile forms were detected under the microscope. But even in this case the lethal period was not prolonged.

"Infection by feeding has been attempted by means of a number of experiments. Sometimes it was successful—in most cases unsuccessful; so that it has seemed to us that the possibility of infection by the mouth depends on accidental lesions about the mouth, nose, ears (in rats), or alimentary tract.

"Of a number of rats fed on organs of nagana animals only a few acquired the disease, and these invariably showed superficial lesions of the snout and ears due to lice. When fed upon infective material, they bury their snouts in it as well as scratch their ears with their blood-stained forepaws. Furthermore, in the rats which acquired the disease through feeding, the cervical glands were always enlarged most, which proves that the hematozoal infection must have taken place in the head, for, as we shall show, the primary infection travels by the lymphatics.

"A cat fed repeatedly on soft tissues of the bodies of infected dogs and cats, and subsequently on the bodies of dead rats, died at a time corresponding by lethal period to an infection at the first meal on rats. We regard it as probable that some splinter of bone caused a superficial lesion through which the hematozoa were enabled to enter.

"One rabbit, fed carefully by means of a pipette with large quantities of infected blood, never showed the slightest sign of the disease. Rouget (1896) also failed to infect animals by the mouth.

"Two rabbits, into whose conjunctival sacs several drops of blood containing very abundant hematozoa, and a third rabbit whose eye was brought into contact with one of these, did not become infected. We presume that Rouget's positive results by this method were due to some accidental lesion.

"A dog suffering from the disease did not infect her puppies during the last 14 days of her life, nor did these puppies infect their foster mother (she cat) after they had been inoculated.

"Nor have we observed transmission of the disease through the mother's milk in guinea pigs. Rouget alludes to a doubtful instance of infection by coitus in rabbits by means of the spermatic fluid. We have not detected hematozoa in spermatic fluid obtained from the vesiculæ seminales, and believe that in Rouget's single positive case there may have been direct infection from the penis, which suffers considerably in rabbits and may become excoriated, so that it easily bleeds.

"We therefore do not believe that it is possible to infect an animal by feeding in the absence of superficial lesions, and in this respect we differ from Bruce, who seems to imply that the hematozoa can pass through the unbroken surface of the alimentary tract.

IV. Symptoms and course of the disease.

"These vary somewhat according to the nature of the animal, but there are certain striking symptoms which commonly occur in different groups of animals. These may therefore be regarded as the most characteristic.

"1. *Muscular wasting* and *loss of power* are evident in all but the small animals. In rats, mice, and guinea pigs they are but little marked or absent altogether. In the horse, dog, cat, and rabbit the wasting is very conspicuous. In the cat, dog, rabbit, and hedgehog there is marked loss of weight, amounting to 20 to 30 per cent.

"2. *Fever.*—In most animals which have been examined there is a smart rise of temperature about the time of appearance of hematozoa in the blood. (Horse, 41.5° C.; dog, 40° C.; rabbit, 41° C.; guinea pig, not constant.)

"Paroxysms of fever are common in the *horse*, as has already been shown by Bruce. The temperature may rise to a considerable height (41.6° C.). The same is true of the zebra-horse hybrids. In a horse upon which daily observations were made, quick and sudden rises of temperature immediately followed an increase of the hematozoa in the blood. At the time of death there was marked pyrexia.

"In the single *donkey* which we examined the temperature was generally raised throughout the course of the disease.

"In *dogs* there is also fever, the temperature becoming subnormal on approach of death.

"In *rabbits* pyrexia is common, and generally the temperature is elevated throughout the disease, but it may fall suddenly to normal. The temperature curve is always irregular, and no relation between the temperature curve and the hematozoal curve could be established.

"In *cats* also the fever is well marked, the temperature falling quickly toward the end.

"It is difficult to speak with certainty of the temperature in such small animals as *rats* and *mice*.

"In *guinea pigs*, representing less susceptible animals, fever as a rule is not a special feature. The temperature is as irregular as it is in the normal animal, but the animal shows paroxysmal rises from time to time, sometimes above 41°. These may be accompanied by an accession of hematozoa into the circulation, but this is not a constant feature.

"3. *Edema* is common in certain animals, such as the horse, rabbit, cat, and dog, and is most marked about the head, legs, belly, or genitals. In smaller animals, such as rats and mice, it is not usual, and in guinea pigs it has not been observed. In dense tissues, as the rabbit's ear, there may be a local edema at the site of inoculation.

"Rabbits exhibit a special tendency to edema of the external genital organs. There is often great and progressive swelling of the prepuce or labia, as the case may be. The swollen parts often excoriate and become sore and covered by crusts, so that the animal is in a sorry condition.

"4. *Changes in the eyes and nose.*—In cats, dogs, rats, and rabbits turbidity of the aqueous humor, fibrinous plaques in the anterior chamber, and corneal opacities are occasionally observed. In rabbits a mucopurulent conjunctivitis is common, and this may be followed by an opacity of the cornea and a turbidity of the aqueous nor, which under such conditions shows hematozoa microscopically as well as ocytes. Hematozoa have also been discovered in the conjunctival discharge in arlier stages of the disease. Vascular corneal ulcers sometimes occur in dogs, the conjunctivitis of cats, dogs, rats, and rabbits is frequently associated with a of the eyelids and face. In rabbits the eyelids and nose frequently become t entirely closed up by the drying of the secretion. In the latter case they he with great difficulty, keeping their mouths open. This condition has been ibed by Rouget (1896).

"5. *Anemia.*—Some degree of anemia is always present, but it does not seem to be so extreme as to be the sole attributable cause of death, and points rather to a disturbance in the hematopoietic or the hematolytic mechanisms.

"The number of red-blood corpuscles steadily diminishes and nucleated red corpuscles (normoblasts) often appear, especially in rats. According to observations on rabbits, the diminution of hemoglobin is roughly proportional to that of the blood corpuscles.

"Leucocytosis is not a constant feature and when present is apparently due to the febrile temperature. An excessive leucocytosis, such as occurs in leukemia, was never observed; 15,000 to 34,000 leucocytes being the highest numbers recorded per cubic millimeter.

"Blood drawn from an animal seriously ill, when clotted, generally exhibits a marked buffy coat; the serum is often turbid and may undergo secondary clotting.

"Instead of forming rouleaux, the red corpuscles tend to clump into masses and to lose their outlines, especially when the anemia is pronounced (rabbit, ass, and horse).

"The serum of such blood, when mixed with normal blood of the same species of animal, causes the red corpuscles to clump together also.

"The urine of infected dogs spectroscopically examined often shows an intense urobilin band.

"Wounds do not heal well, and tend to break down and become septic, even though the operation has been performed with strict aseptic and antiseptic precautions. The hematozoa may be abundant in the discharge from the wounds. Many animals, especially dogs, are apt to become infected with pyococci and other bacteria in the later stages of the disease, even when the inoculated material has been proved to be free from bacteria. We conclude that a spontaneous terminal bacterial infection may occur when the marasmus has reached a certain degree. This may accelerate death and is probably fairly often the case in the naturally acquired disease. But we have often proved by cultures that bacteria are absent in uncomplicated cases of experimental inoculation.

"7. A voracious appetite has not been observed in the infected laboratory animals; some animals refuse their food and the stomach is not seldom empty after death.

"8. Rats and guinea pigs often exhibit convulsive or eclamptic seizures shortly before death, but otherwise guinea pigs, rats, and mice show no symptoms of disease, except dullness in the later stages.

"9. Transmission from one animal to another, without direct inoculation, has never been observed. Nor have we come across instances of infection by coitus or through suckling, although we have dealt with large numbers of animals.

V. Morbid anatomy.

"In *rats* and *mice* exactly the same conditions may be observed. The most striking changes are:

"(1) Enlargement of the lymphatic glands, the glands corresponding to the seat of inoculation being always largest. This observation is important, because from the relative size of the glands it is possible to determine the seat of infection. To this allusion has already been made, when the effects of feeding were discussed. The glands are generally red, congested, juicy, and edematous; in a few instances hemorrhagic extravasation has been observed. In some cases all lymphatic glands in the body are enlarged, in others a particular series only. If a rat be inoculated in the right thigh, the glands in the left axilla and left groin suffer last.

"(2) The spleen is much enlarged, with but few exceptions, and it is generally firm, friable, and dark colored.

"(3) The liver generally shows some enlargement and may be fatty.

"(4) Wasting of the muscles and atrophy of the fat is, as a rule, not well marked.

"(5) Subpleural ecchymoses are sometimes present in the lungs, accompanied by a small amount of pleural fluid.

"In *rabbits* the general enlargement of lymphatic glands is less noticeable. The spleen is generally enlarged. Petechial ecchymoses are rare. Fatty degeneration of the liver is always present, and muscular wasting is often extreme. Enlargement of testes has been observed.

"In *dogs* muscular wasting is well marked, the animal being often reduced to a skeleton, but the fatty tissues are generally not much affected, except at the base of the heart, where the fat may undergo edematous degeneration. The general enlargement of the lymphatic gland is well marked, and, as in the rat, the glands are edematous and congested, yellowish, or even show hemorrhagic extravasations.

"The spleen is also greatly enlarged, granular, firm, and friable.

"Pericardial effusion is common; pleural effusion may be present.

"Subpericardial petechiæ and hemorrhages occur frequently, subperitoneal occasionally, and sometimes also submucous in the intestines and stomach.

"In *cats* wasting is pronounced, the glands are greatly enlarged, the spleen is also enlarged, the liver is slightly enlarged. Hemorrhages beneath the pleura and pericardium have been noticed.

"In *guinea pigs*, which clinically often show no changes or symptoms at all, the morbid changes after death are not very well marked. The spleen is generally moderately enlarged, and occasionally even considerably; it is often very soft and rather pale. The lymphatic glands are distinctly, but as a rule only slightly, enlarged, those corresponding to the seat of inoculation being always the most affected.

"Hemorrhages have been observed in the lungs and in the stomach; serous effusions and edema have not been noted.

"In all these animals the bone marrow is sometimes dark red in color, at other times natural, or paler than it should be. In the shafts of the long bones the fat disappears and becomes replaced by 'red' marrow.

"In many cases an iron reaction has been obtained with the liver, spleen, and kidney (ammonium sulphide; and $K_4FeCy_6 + HCl$).

VI. Distribution of hematozoa.

A. Blood.

"After a latent period of some days, hematozoa are invariably found in the blood at some time or other during the course of the illness.

"1. *Rats.*—When the animal is inoculated with small quantities of infective blood, the latent period averages 3 to 4 days. When, however, a large number of hematozoa is inoculated into the peritoneal cavity, the parasites may be found in the blood even after a few hours.

"When the hematozoa have once appeared in the blood, they are generally found therein to the end, gradually increasing in number till the blood literally teems with them. During the early stages of the disease, however, variations are frequently noted, inasmuch as an increase on one day may be followed by a marked decrease on the next. In a few cases they have even temporarily disappeared from the circulation for a day or two, but this is distinctly rare in rats and mice, although common in other animals.

"At the later stages the hematozoa may amount to 2,000,000 to 3,000,000 per c. m.

"2. *Mice.*—What has been said of rats applies also to mice.

"3. *Rabbits.*—In these animals, after inoculations with minute quantities of blood, the parasites first appear in the blood in about 8 days, about the same time as the pyrexial attack. They remain in the general circulation for a day or two in small numbers; this is followed by a disappearance and reappearance for a variable number of days at irregular intervals. In the animals which have been systematically examined the hematozoa do not appear abundantly until toward the close of the disease; the largest number which has been estimated near the time of death has been 60,000 per c. m. (compare rats and mice), but even at that time they may be scanty and difficult to find. They are also to be found in the fluid of the local edema and discharge from wounds, conjunctiva, or genitals. Although hematozoa may be so scanty that they can not be discovered by the microscope (sometimes even after centrifugalizing), the animals show marked clinical symptoms. Their blood has often been proved to be infective.

"4. *Dogs.*—Early in the disease, from 4–6 days, the hematozoa may be absent from the blood, but observations on their presence during life in the lymphatic glands have not been made. Toward the end they become very numerous (100,000 to 300,000 per c. m.). Variations in the number of hematozoa are common, but as a rule hematozoa are numerous throughout the disease.

"5. *Cats.*—The latent period is about 5 days; then the hematozoa appear in the blood, and, with daily variations, quickly increase in number. The variations are sometimes remarkable; thus on one day the hematozoa may be extremely numerous, while on the next day they will have become scanty.

"6. *Horse.*—Systematic observations on this animal, as well as on the donkey, have been made by Bruce. In our first horse the latent period was 7 days. The first appearance of hematozoa in the blood was followed by a sharp rise of the temperature. After the hematozoa once showed themselves they were generally scanty and often absent (the centrifuge was not used), but an appearance of the hematozoa in the blood was generally followed immediately by a paroxysm of fever. A few days before death, however, the number increased greatly, falling again to zero 2 days before death and being low at the time of death.

"7. *Guinea pigs.*—After a subcutaneous inoculation, a few hematozoa will generally be found in the blood about the fifth to seventh day. They may then again disappear and reappear from time to time, to disappear again after a few days. This alternation may go on for weeks. Then suddenly the hematozoa become numerous and gradually increase, sometimes with irregular variations, till the blood is almost crowded, 200,000 to 500,000 per c. m. being present. The guinea pigs die, generally without showing any symptoms, except perhaps convulsive attacks a day or two before death.

"In some cases no hematozoa have been found in the blood for over 6 weeks, although it has been examined daily. They then appeared in small numbers, and after remaining scarce for a week or so, suddenly and rapidly increased as the disease approached its fatal termination. It is, however, more common to find a few hematozoa about a week after inoculation, this being followed by a more or less prolonged period of absence.

"In cases where the disease runs a less protracted course, the hematozoa become numerous about 4 weeks after the inoculation, when they are often present in large numbers; but, as in the case of other animals, the number of hematozoa may be very variable, being almost enormous one day and very considerably less, or even very small, the next. In a case where the guinea pig had been bled before inoculation the disease ran a rather short course; hematozoa appeared 9 days after the infection, rapidly rising in number to over 128,000 per c. m., the animal dying after 22 days. In a few cases where the lymphatic gland corresponding to the seat of inoculation was examined, hematozoa were found in the gland, while they were absent in the blood.

B. Lymphatic glands.

"In the rat the superficial lymphatic glands may be readily examined by piercing them with fine capillaries or sharp needles; they may also be excised and examined more thoroughly. Although a considerable number of observations have been made by these means, and also after killing the animals at various periods after inoculation, we wish to speak somewhat guardedly, since the appearances are not quite constant. Moreover, we are at present unable to be certain that unrecognized developmental forms have not been overlooked.

"By the study of the right inguinal glands after subcutaneous inoculation in the right thigh, we find that the hematozoa are present from 1 to 3 days before they are discoverable in the blood (taken from the ear or right leg). Again, they may be very abundant in the gland when they are still scanty in the blood. Moreover, the number in the blood may increase, while that in the gland decreases. In these earlier stages the hematozoa may be extremely numerous, forming tangles and clusters in the lymph gland, while only a few scattered ones are to be found in the blood. The first appearance of hematozoa in the gland of the other side is apparently associated with their appearance in the blood.

"The observations, fewer in number, which have been made upon guinea pigs, also point to a multiplication in or about the nearest chain of lymphatic glands in the first instance.

"We have not yet determined whether these hematozoa pass directly into the blood through the local blood vessels or whether they are distributed by means of lymphatic paths into the main circulation.

"The animals may appear comparatively well while large numbers of parasites are present in their blood and glands; this is especially the case with rats and guinea pigs. On the other hand they may be seriously ill while the hematozoa are scanty in their blood; this obtains usually in rabbits, in which animals, as already stated, the glands do not become so much enlarged, and it is possible that the main effect of the parasites is borne by other organs. For instance, at times the bone marrow has shown the presence of hematozoa, although search in other organs and in the blood proved negative.

"After death in the various animals hematozoa are to be found in most cases in the bone marrow and spleen. The adult hematozoa may be common in these situations when but few are present in the blood; but this is not constant, for the reverse may be the case. Multiplication of the parasites certainly takes place in the lymphatic glands (rat) as well as in the infected area of connective tissue. It may also occur in the above-mentioned organs as well, and perhaps, too, in the blood, but of this we have no certain evidence.

"The hematozoa are also found in the fluids of the serous cavities, at any rate when they are present also in the blood.

"They have not been found in the intestinal contents, nor have they been seen in the urine, except in one case in which hematuria and submucous petechie of the bladder were present (rat).

"It is evident from these observations that, in order to investigate the development of the hematozoa in the rat, etc., special attention must be paid to the seat of inoculation and the nearest lymphatic glands.

"Dead and nonmotile forms may frequently be found in the circulation and in the lymphatic glands when the disease is advanced. These are less defined and are ghost-like, being somewhat swollen in appearance; they are also generally in an extended condition.

VII. Toxic power of the blood.

"The fact that animals may appear to be well for days while hematozoa are abundant in their blood suggests that the hematozoa do not secrete much, if any, specific toxin, and indeed so far no direct evidence has been obtained of a potent poison manufactured by the hematozoa, either by secretion or by chemical changes induced in the blood.

"Fresh serum after filtration through Berkefeld filters, and blood or serum which had been kept for days in a sterile condition till the hematozoa had died, have had no specific toxic effects, even when large quantities have been injected into dogs, rats, or rabbits. Blood in which the hematozoa have been killed by exposure to 50° C. has had no more effect. The extracts of organs obtained from diseased animals have also shown no poisonous properties.

"The whole available blood of highly diseased rabbits has been injected immediately after removal into healthy rabbits without producing immediate symptoms of acute intoxication.

"The bile of diseased animals does not appear to be more toxic than that of healthy animals.

"A cat, into the peritoneal cavity of which a collodion sac full of fresh infected blood had been inserted, showed no signs of illness. It was fully susceptible on subsequent inoculation.

"Dogs, when injected with large quantities of filtered serum from an infected dog, showed no symptoms of a profound toxemia.

"Our experiments do not point to the presence of any intense specific toxin or poison in the blood.

VIII. Immunization and cure.

"The endeavors to produce immunity, or to cure the disease after its establishment, are shortly summed up as follows:

"1. Animals which have been repeatedly injected with blood or serum of nagana animals, such blood or serum having been previously freed from living hematozoa, either by filtration, heat, or by allowing it to stand for a week or longer, have not shown the slightest degree of an acquired immunity. Rats, rabbits, and dogs have been tested in this manner, but none of these animals have shown any diminution in susceptibility.

"2. Animals repeatedly injected with extracts of the organs of diseased animals have acquired no resistance.

"3. The blood of almost full-term fetuses, prematurely born of highly diseased rabbits, has been tried, but without the slightest success in prevention or cure.

"4. The guinea pig being a comparatively resistant animal, its serum has been used, but it also has no immunizing action.

"5. Repeated inoculations of bile of diseased animals have been without preventive or curative effects, although *in vitro* bile, which is always free from hematozoa, rapidly destroys the hematozoa. Infective blood mixed with sufficient bile becomes noninfective, but confers no immunity.

"6. Previous inoculations with the hematozoon of the ordinary rat (*T. sanguinis* [*T. Lewisi*]) have also been valueless.

"7. Sewer rats and white rats which have been repeatedly, but unsuccessfully, inoculated with the ordinary rat hematozoon (*T. sanguinis* [*T. Lewisi*]), and have been proved to be refractory to further inoculations with this hematozoon, have all contracted nagana when subsequently inoculated, and have died in the same time as control animals treated with an equal dose of infective blood.

"8. The young born of infected mothers (dog, guinea pigs) are no more resistant than those born of normal animals.

"9. As already stated, by constant transmission through different species, the nagana hematozoon has shown no definite loss or gain in the intensity of virulence.

"10. Of immunizing sera the diphtheria antitoxin and antistreptococcus serum have been used, but, as we expected, without the slightest effect; they neither protect nor cure.

"11. *Dieting.*—Rats have been fed, on the one hand, exclusively with meat, and, on the other, with green vegetables; in neither case has any increased resistance or prolongation of life resulted from this alteration in diet.

"12. Excision of the lymphatic glands immediately after inoculation or after they have begun to show enlargement has been of no avail.

"13. Feeding with hematozoa also conveys no immunity.

IX. *Allied hematozoa.*

[See also pp. 63–73.]

1. *Trypanosoma sanguinis* [*T. Lewisi*].

[See also p. 63.]

"As already mentioned, in sewer rats (*Mus decumanus*) a *Trypanosoma* may be found in a certain percentage of individuals. This hematozoon is distinct from that of nagana morphologically, and also as regards its pathogenic effects. Thus (1) the *T. sanguinis* [*T. Lewisi*] has not been communicated to the dog, cat, rabbit, or mouse, even when large quantities of blood were used for inoculation. (2) In some guinea pigs it has been found in very small numbers in the blood for two or three consecutive days, usually from about the fifth day after injection; but there has been no persistence. (3) In white rats many unsuccessful inoculations have been made with the *T. sanguinis* [*T. Lewisi*], even with considerable doses, and it appears that the minimal infective dose is larger than with the nagana *Trypanosoma*. (4) White rats may lose the hematazoon after they have been proved to have been successfully inoculated with the *T. sanguinis* [*T. Lewisi*]. (5) Some of those which had had, and then lost, the parasite proved refractory on reinoculation. Black and white (piebald) rats have never been successfully inoculated in our experience. (6) No rat has been successfully inoculated with the *T. sanguinis* [*T. Lewisi*], except at the first attempt. (7) We have not been able to recognize any illness after successful inoculations with *T. sanguinis* [*T. Lewisi*]. Any pathogenic effect it may have must be slight. Infected rats remained alive for months; we have not observed any instance where death was to be ascribed to the hematozoon.

"R. Koch[a] examined rats in Dar-es-salam, and also recognized differences between the hematozoon of the local rats and the *Trypanosoma* of the tsetse disease. Whether the *Trypanosoma* occurring in the African rats examined by him is identical with that occurring in our English rats we can not decide, although from the brief description given by Koch they certainly closely resemble each other. Nor did Koch succeed in infecting animals other than rats with the African rat *Trypanosoma*. He therefore showed that the parasites which occur in the blood of rats (in Dar-es-salam) do not stand in any relation whatever to the tsetse disease of horses and cattle. In this connection the observations of Bruce are of great value, because they prove that in big game the tsetse parasite certainly does occur without apparently causing acute, fatal, or even obvious disease; in the same manner, this parasite may sojourn in the body of the guinea pig for weeks and months without interfering with the health and development of the animal for a long time. Furthermore, Bruce (in an unpublished report) has made similar observations on the South African goat and sheep; he shows that in these animals the disease runs an extremely protracted course, and lasts for months.

2. *Trypanosoma of surra* (*Trypanosoma Evansi*).

[See also p. 65.]

"Koch announces that the disease known as surra in India and the tsetse disease of Africa are produced by the same parasite. His reasons for this assumption are apparently not based on extensive personal comparative observation.[b] Lingard, working in areas naturally infected with surra, has not clearly distinguished between the Trypanosoma of surra and that occurring in rats in India. His account of surra as it occurs in rabbits and guinea pigs and rats is suggestive of this disease being closely similar to nagana, but it is impossible for us to pretend to give any final decision in the matter. To illustrate the confusion in which Lingard has placed the matter, it may be pointed out that he writes that cows, horses, monkeys, and field rats are susceptible to inoculation with the ordinary Indian rat hematozoon, but that rabbits, guinea pigs, dogs, cats, and donkeys are insusceptible, but he adds that the latter animals are susceptible after this rat hematozoon has been passed through the horse. He also asserts that surra can be produced in horses by feeding on the excrement of rats. These observations are calculated to create a certain amount of suspicion, particularly when it is remembered that Vandyke Carter failed to infect horses with the Indian rat *Trypanosoma.*[a] For the present, therefore, the question must be left open till an opportunity arises of studying the various parasites at the same time side by side, both in their morphology and pathogeny.

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[a] Reiseberichte, 1898a, pp. 70 and 71.

[b] Reiseberichte [1898a], p. 66.

3. *Trypanosoma of Rouget.*[b]

[See also p. 67.]

"Rouget describes *Trypanosoma* disease in Algeria, which apparently is identical with the disease described by Bruce. Judging from the drawings and descriptions, his parasite agrees with that of nagana. He will not commit himself as to the identity of his parasite with that of surra. White rats and mice, rabbits, and dogs exhibited a considerable susceptibility, while guinea pigs, he says, were refractory (possibly because he did not recognize the chronicity of the disease). Sewer rats were not always susceptible, while some showed a relative immunity. It seems, however, that he did not reinoculate them so as to test their immunity again. His description of the symptoms and anatomical appearances in mice, rats, rabbits, and dogs agrees almost exactly with our own observations. He claims to have succeeded in immunizing a number of mice by injecting them with the serum of an infected rabbit previous to inoculating the *Trypanosoma;* six mice survived altogether,[c] while others lived for 17 to 23 days. As a curative agent this serum was useless. Guinea pigs' serum also had no preventive action.

X. *Biology of the nagana hematozoon.*

"So far our knowledge of the nagana parasite, as that of other Trypanosomas, is very incomplete. Rouget[d] has failed to find forms corresponding to those described by Danilevsky in birds and by Shalashnikov in rats, and Lewis and others have been equally unsuccessful, while it is difficult to follow Lingard in his description of young forms. We have not succeeded in tracing a life history, and we are still in search of developmental forms, a task which at present occupies our special attention.

"1. Most commonly in blood, etc., drawn from infected animals the forms described by Bruce are found. They are generally in active movement and can sometimes be observed in locomotion with their flagellated end forwards, as Lewis described in the case of other hematozoa; in many cases they do not change their position by free swimming, but tend to fix themselves by one or other end to the coverslip or to corpuscles or cells in the specimen. They then exhibit more or less rapid oscillations, and may change their position by apparently drawing or pushing themselves in one direction or the other. Meanwhile the vibratile membrane waves rapidly and the protoplasmic body alters in shape, becoming thicker and shorter or thinner and longer. In the case of the English rat hematozoon free swimming is the rule. Changes in the shape of the body like those of the nagana organism are not observed.

"2. The nagana parasites vary considerably both in size and form; they may be long and pointed or blunt-ended and somewhat stouter. Some individuals are short and thick with a short flagellum, their protoplasm being crowded with rounded granules. Still larger forms possessing more than one vibratile membrane are sometimes, though rarely, met with.

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[a] Scientific Memoirs of Med. Officers of the Army of India, 1887, Part III, p. 56.

[b] Annales de l'Institut Pasteur, 1896, vol. 10, p. 716.

[c] It does not appear whether they were again tested.

[d] Loc. cit. [1896], pp. 722 and 723.

"3. Especially in specimens taken from lymphatic glands, but also in specimens obtained from the blood, etc., there is a clear vacuole at the thick end. This does not become stained with staining reagents. It varies much in size in the different individuals, but we have watched in vain for evidence that it is of a contractile nature.

"4. By means of hemalum or hematoxylin a nuclear body can be demonstrated in the middle of the parasite. It is usually oval, but may be more saddle-shaped. The protoplasm also contains a number of granules which stain with basophil reaction (methylene-blue, thionin, etc.); these are somewhat variable in number, being fewer in specimens in which the protoplasm is more refractive, e. g., from lymphatic gland. These granules are distributed irregularly throughout the body of the parasite; they do not occur in the membrane or the flagellum. The chromatin spot situated close to the nonflagellated end in the *T. sanguinis* [*T. Lewisi*] is not defined in the nagana *Trypanosoma*. The *T. sanguinis* [*T. Lewisi*] also does not stain at all readily even by basic aniline dyes (dahlia, fuchsin, etc.) while that of tsetse disease is more readily colored by these reagents.

"5. Examples joined by the poles opposite the flagellum are common at times, but although they suggest perhaps conjugation, we have no evidence that this process does really occur. After prolonged observation no further changes have been noticed in these jointed individuals.

"In freshly drawn blood, or in the lymph of lymphatic glands, or in pleural and peritoneal fluid, when the hematozoa are common, tangles made up of numerous hematozoa have been observed; this has been already described by Lewis. The hematozoa often converge with their nonflagellated ends toward one common point. In lymphatic glands, before the hematozoa are found in the blood, such tangles may be present in great numbers.

"6. Forms consisting apparently of two individuals joined side by side by their bodies, the flagella being free, have been observed on rare occasions; from prolonged observation in the living state we have no reason to suppose that these are undergoing longitudinal fission. Especially in kept blood, etc., many of the hematozoa may present a rhomboid outline while still motile.

"In drawn blood or serous fluids the hematozoa eventually become motionless; this may occur rapidly, for instance in 20 minutes, but generally some motile specimens can be found after 2 to 3 days—sometimes, indeed, after as long as 5 or 6. When they are abundant, the tangles above noted are formed. Then the bodies of the organisms become rounded, the nuclear bodies becoming more distinct and readily stainable (hematoxylin or basic aniline dyes). At the same time the vibratile membrane or fin and the flagellum separate, forming a rather rigid filament. Eventually (generally after 3 to 4 days) masses of spherules alone remain; these apparently correspond to the nuclear bodies. In numerous experiments these structures have uniformly proved to be noninfective, and it must therefore be inferred that if they are not simply degeneration products, they require other conditions for their further development than those that are found in warm-blooded animals. All individuals, however, do not pass through these changes; some, or even all, may simply become nonmotile, stiff, and pale, at the same time retaining their form. In numerous attempts at cultivation in normal blood, similar phenomena are observed without any evidence of multiplication. Within a corpse the blood and organs become noninfective in about 24 hours, the changes in the hematozoa being similar to those just described.

"Exposure for several hours in an atmosphere of hydrogen or CO_2 has no appreciable effect on the motility of hematozoa in blood-free serous fluids. The hematozoa are also fully active in hosts killed by ether, chloroform, or coal gas.

"7. Oval forms, smaller than the ordinary hematozoa, with (or without) a shor flagellum, and often with a 'beak' at the opposite pole, have been observed in the organs, but rarely in circulating blood.

"8. Small rounded or ovoid bodies, about 1 to 2 μ in diameter, hyaline, sometimes with a refringent chromatin spot or bipolar spots, or irregular (? amoeba-like) bodies, also sometimes with a chromatin spot and of the same size or rather larger, have been observed, especially in the lymphatic glands and bone marrow, or spleen. It is possible that these are early stages in the development of the hematozoon. No forms have been seen at any time within the red-blood corpuscles.

"9. Neither sporocystic nor larger distinctly amoeboid forms have been observed.

"As our observations on the development of the parasites are still in an incomplete condition, this short statement must suffice, and a more detailed description must be eft for a future occasion, when we submit a full report upon our work."

MAL DE CADERAS.

In South America there exists an equine disease which is more or less closely related to surra and dourine. Lecler (1899, p. 6) was inclined to consider it of bacterial origin, but Elmassian (1901a, p. 604) and Voges (1901a, p. 598) consider it due to a *Trypanosoma*, for which Voges proposed the name *Trypanosoma equinum*. The parasites are most numerous in the circulation during the rise of temperature. Upon its reaching 40° to 41° C., they gradually disappear, but reappear upon the next increase in temperature. In length the trypanosomes are three to four times the diameter of a red-blood corpuscle.

This malady extends from the Argentine provinces St. Fe and Corrientes on the south to Chaco, Missiones, Paraguay, Matto Grosso, and Bolivia on the north. It is a "wet weather" disease, which almost completely disappears in dry seasons. Horses, mules, asses, swine, and water hogs are said to be affected, and horses are never known to recover. It is chronic in course, lasting 2 to 5 months in horses and 6 to 12 months in asses and mules. The clinical symptoms are described as an intermittent fever, the temperature usually rising slowly, then suddenly falling to normal; rapid progressive emaciation; dark-red urine occasionally containing albumen and blood; the red-blood corpuscles decrease in number, and the microscopic changes of pernicious anemia appear; the lymphocytes and especially the eosinophiles increase considerably in number; the most marked symptom is a symmetrical or an asymmetrical paresis of the hind legs; defecation and urination (coinciding with paralysis of the sphincter ani and of the bladder) difficult; dyspnea; appetite and extreme thirst preserved to the last; gradual extension of the paralysis to other parts of the body; edema frequent. On postmortem there are noticed enlargement of the spleen and of the lymphatic glands; serofibrinous exudations in the body cavities; liver enlarged and engorged with blood; heart flabby; lungs, often with hemorrhagic herds, and subpleural emphysematous patches; catarrhal condition of the respiratory passages, and pathologic changes in the spinal cord.

The blood is infectious upon inoculation, but not upon ingestion; white and gray rats and mice, rabbits, guinea pigs (rarely), dogs, goats, sheep, chickens, turkeys, ducks, monkeys (*Nyctipithecus felinus*), and other animals are said to contract the disease upon inoculation.

Treatment with quinine, methylene blue, arsenic, enterol, permanganate of potassium, and other drugs has been without success.

[Since the above was sent to press, an extensive and valuable article on mal de caderas has been published by Voges (1902, pp. 323–372, pl. 5, figs. 1–7), to which the reader is referred for further details.]

TRYPANOSOMIASIS IN RATS AND BANDICOOTS.

RAT.

Considerable confusion has resulted in literature because of the misinterpretation of trypanosomiasis in rats. Thus the parasite of horse surra in India has been confused with the common trypanosome of Parisian and London rats. From present data it appears that rats (*Mus decumanus* and others) may harbor at least five species of *Trypanosoma*, namely: (1) *Trypanosoma Lewisi*, the form usually known as the rat trypanosome, and usually looked upon as a comparatively harmless organism. It is apparently quite common in rats in wet weather, while four other species—namely, (2) *Trypanosoma equiperdum*, the supposed cause of dourine; (3) *Trypanosoma Brucii*, the cause of tsetse-fly disease; (4) *Trypanosoma Evansi*, the cause of surra; and (5) *Trypanosoma equinum*, the cause of mal de caderas—are all transmissible to rats.

It is quite apparent from Lingard's accounts that he did not always distinguish between *Trypanosoma Lewisi* and *T. Evansi*, and this fact explains a number of apparently contradictory results in his experiments.

Thus, Lingard (1894a, pp. 4–5) says:

> EXPERIMENTS ON ANIMALS WITH THE HEMATOZOON OF THE RAT.
>
> "Proof was wanting that this hematozoon was capable of producing surra, when blood containing the organism was subcutaneously injected into horses and some other species of animals. As early as November, 1890, I commenced a series of experiments for the purpose of deciding the above question and obtained positive results, but found that the periods of incubation were more prolonged than in horse surra, in one case being as much as 63 days. Notwithstanding this, the virulence of the disease when once developed was intense, as shown by the short period during which the animal survived after the appearance of the hematozoon in the blood, this being in three cases only 2 to 5 days.
>
> INOCULATION WITH THE SOILED BLOOD OF THE RAT (*Mus decumanus*).
>
> "Of 12 horses inoculated with soiled rat's blood, 4 animals contracted surra, or 33.3 per cent:
>
> (1) Period of incubation lasted 18 days; animal lived 19 days.
> (2) Period of incubation lasted 29 days; animal lived 2 days.
> (3) Period of incubation lasted 13 days; animal lived 2 days.
> (4) Period of incubation lasted 63 days; animal lived 5 days.

'Although the latent period of rat surra was so prolonged in the first instance, when inoculated from rat to horse (average 40.7 days), it immediately returned to the normal period (average 7 to 8 days), when a second horse was inoculated with the blood of the first affected. The latent period, however, becomes still more reduced (5 days) when a third animal is inoculated with the blood of the second.

"2. Horses unsuccessfully inoculated and reinoculated subcutaneously with the rat hematozoon, when subsequently inoculated with horse surra blood show no protection from the former, but acquire the disease after an incubation period of 6 to 10 days.

"3. Animals other than horses which contracted the disease were bovines, monkeys, and field rats, while the rabbit, guinea pig, fowl, cat, dog, and donkey proved refractory to the rat hematozoon. But all the above animals with the exception of the fowl were very susceptible to the rat hematozoon when it had first been passed through the horse.

EXPERIMENTS ON THE GASTRIC INGESTION OF RATS' EXCREMENT.

"The above experiments raised the question as to how rats could cause the disease in horses; for the food would rarely if ever be soiled with the blood of these animals. It therefore only remained to be tried whether the excreta of rats, in whose blood the infusorian was present at the time of its collection, could cause the disease when mixed with grain.

"2. In 1892 experiments were undertaken at Poona, on the Deccan plateau, where the disease is not enzootic, and where the difficulty of producing it was fully recognized, owing to the dryness of the situation at that period of the year (December to February). These experiments, as expected, proved negative.

"3. At a later date, during the latter half of the hot season and the rains of 1893, further experiments with the same end in view were carried out in Bombay, where the climate is favorable from its humidity and the disease is enzootic. From these positive results were obtained, the incubation period occupying 4 months (about June to September); but the incubation period of the disease will probably be found to vary with the amount of moisture present in the atmosphere and amount of *materies morbi* ingested by the animal. This points to the probability of a number of the surra cases in Bombay being contracted through the ingestion of rats' or bandicoots' excreta mixed with the corn. Although not yet definitely proved, it is more than likely that the excreta of young and half-grown bandicoots have the same power of producing the disease, as the hematozoon is also frequently present in their circulation."

It seems to us that the above statements indicate very clearly that at least two species of *Trypanosoma* were present.

Despite this confusion, Lingard (1895, p. 10) presents some exceedingly interesting facts regarding trypanosomiasis in rats. Thus, from November, 1890, to May, 1895, the blood of 3,105 rats (*Mus decumanus*) was examined microscopically, and 1,084, or 34.91 per cent, were found to contain *Trypanosoma*, while in 2,021 cases, or 65.09 per cent, the examination was negative.

In an earlier paper Lingard (1894, pp. 3–4) brings out the following points, which are of interest in the way of comparison:

"Dividing the (Bombay) year into two periods—

(1) Dry and hot (January to May, inclusive),

(2) Rainy and humid (June to December, inclusive),

we find that during the period November [1890] to July, 1894, 421 out of a total of 1,107 rats examined contained the hematozoon in their circulation. It was present in 31.53 per cent of the rats caught from January to May, and 40.31 per cent of those obtained from June to December, or during the rainy season. Although in the hot season the hematazoon is present in the circulation of these animals, the organisms are very few in number, while during the latter period of the year they are far more numerous, the percentage of cases in which the hematozoa are very numerous or swarming being 24 in the dry season and 52.61 in the rainy season, or in a ratio of 1:2.19.

"3. There is a tendency in the hematozoon to disappear from the circulation of some rats when kept in captivity and supplied with clean food and water.

"4. About 60 per cent of young rats from 2 to 4 months old have the hematozoon present in their circulation, and usually in large numbers.

"5. The blood of rats obtained from certain localities was almost always free from the hematozoon, while that of the majority of rats from other localities was affected.

"6. The hematozoon of the rat appears to disappear from the circulation at irregular intervals, thus producing paroxysms and intermissions, as in the case of surra in the horse.

"7. The presence in varying numbers of the hematozoon in the circulation of rats does not appear to produce any noticeable symptoms in the great majority of them. But some few rats whose blood swarmed with the hematozoon have succumbed to leucocytosis, with extravasations of blood containing the organism into the anterior chamber and vitreous humors of the eye, opacity of the cornea, enlarged spleens, and extravasations of blood, or in some cases ulceration of the mucous membrane of the stomach.

"8. It has been observed in a considerable number of cases that although the hematozoon may be present in vast numbers in the blood of pregnant rats (*Mus decumanus*), in no case has the hematozoon been discovered in the circulation of the fetus.

"9. *Parasites, stomach.*—Nematode worms varying in number and dimensions were found in the stomach of rats in which the hematozoon was either present or absent. In a total of 203 examined, nematodes were found in 40, or 19.75 per cent.

"10. *Saliva.*—Microscopical examination of saliva proved the absence of the *Trypanosoma* when the hematozoon was swarming in the blood at the same time. Immediately, however, a slight wound of the mucous membrane of the mouth was made, the organisms were discovered in varying numbers, according to the amount of blood mixed with the saliva.

"11. *Urine.*—The hematozoon was always absent from the urine of rats, although swarming in the circulation at the time of examination.

"12. *Bandicoots* (*Mus* (*Nesokia*) *giganteus*).—Previous observers have denied the presence of the hematozoon in the bandicoot, but as early as 1892 I demonstrated the presence of the organism in the blood of young and half-grown animals of this species, whether caught in Bombay and its surroundings or on the Deccan plateau, but it has been absent from all full-grown animals examined.

"13. *Muskrats* (*Sorex cœrulescens*) *and mice* (*Mus* species).—The hematozoon has not been found in the blood of these animals."

In his summary of 1895 Lingard (1895, pp. 11–13) adds the following interesting statement:

"3. It will be seen in column No. 8 that the percentage of rats in which the organisms were present in the circulation was highest during those months which included the monsoon season, namely, June to October, inclusive; and during the remaining months the percentage gradually decreased until April was reached. The difference between the maximum, 46.70, and the minimum, 23.47, percentages in July and April, respectively, is 23.23, or nearly half (50 per cent).

Table showing the ratio of spleen weight to body weight when the hematozoon is present or absent from the circulation of rats (Mus decumanus), *male and female, whose body weights are over or under 60 grams.*

Hematozoon present or absent in the blood.	Number of rats.	Males under 60 grams, ratio S. to B. W.	Number of rats.	Females under 60 grams, ratio S. to B. W.	Number of rats.	Males over 60 grams, S. to B. W.
Absent	186	1:228.4	171	1:232.2	455	1:205.5
Few	49	1:139.8	48	1:201.5	104	1:190.0
Numerous	44	1:136.6	32	1:166.8	37	1:154.3
Very numerous	47		28		22	
Swarming	78	1:107.2	55	1:119.2	23	1:137.9
Total	404	....	334	....	641	....
Present	218	1:125.7	163	1:157.4	186	1:169.1
Absent	186	1:228.4	171	1:232.2	455	1:205.5
Total	404	....	334	....	641	....

Hematozoon present or absent in the blood.	Number of rats.	Females over 60 grams, ratio S. to B. W.	Number of rats.	Males and females under 60 grams, ratio S. to B. W.	Number of rats.	Males and females over 60 grams, ratio S. to B. W.
Absent	578	1:203.3	357	1:230.3	1,033	1:204.3
Few	95	1:144.3	97	1:165.7	199	1:165.7
Numerous	29	1:137.4	76	1:147.4	66	1:146.9
Very numerous	23		76		45	
Swarming	22	1:087.5	133	1:112.0	45	1:108.1
Total	747	....	738	....	1,388	....
Present	169	1:131.2	381	1:139.3	355	1:149.9
Absent	578	1:203.3	357	1:230.3	1,033	1:204.3
Total	747	....	738	....	1,388	....

"5. It will be seen from the above table that the weight of the spleen increased (from a minimum in the absent cases) in regular gradation according to the number of hematozoa present in the circulation of the rats.

"6. *Pregnant.*—Of 2,154 rats examined 1,070 were males and 1,084 females. Seventy-seven females were pregnant, the hematozoon being present in the blood of 19 and absent from it in 58; or a percentage of 32.75, as against 67.25. In no instance has the *Trypanosoma* been discovered in the circulation of the fetus, although at the same time it was present in varying numbers in the blood of the mother.

"7. *Parasites* (stomach).—Nematode worms, varying in number and dimensions, were found in the stomachs of rats (in some instances the above organ was fully distended by the number of parasites), in which the hematozoon was either present or absent.

"In 2,154 examined during the year, nematodes were found in 23.58 per cent. But [illegible] to note that during the rainy season—June to November—the per- [illegible] whilst during the months December to May it rose to 29.36 per [illegible] ge varied during the twelve months from 7.25 in July to 37.50 in [illegible]

[illegible] ority of rats present the hematozoon in their circulation sometime [illegible] on. From our observations the spleen attains its maximum [illegible] rains, and from that period the size of the organ gradually [illegible] d hot season, until the advent of the following monsoon, [illegible] all between November and May.

"9. It has been observed during the middle of the hot and dry season that when rain suddenly falls after a long period of drought (4 months) the percentage of animals in which the hematozoon is found increases rapidly in the first few days (7) following the fall. The percentage then rapidly falls, and a second maximum is reached during the fourth week.

"The increase of percentage in the first week was found to be 7.5, while the maximum in the fourth week was 11 per cent.

EXPERIMENTS WITH THE HEMATOZOON OF THE RAT (*Mus decumanus*).

"Horses injected subcutaneously on numerous occasions with rat's blood containing swarms of the hematozoa proved refractory to the rat disease, but readily contracted surra in the usual period (5 to 7 days) when a small scratch on the muzzle was smeared with a trace of soiled guinea pig blood.

BANDICOOT.

EXPERIMENTAL INVESTIGATIONS RE HEMATOZOON IN BANDICOOTS.

Showing the bandicoots (Mus (Nesokia) giganteus) *examined from July, 1894, to end of April, 1895, and the relative number of hematozoa in their circulation.*

Hematozoa in blood.	In field of microscope.	Number of bandicoots.	Percentage.
Absent	....	112	74.65
Few	1 to 5	7	4.66
Numerous	5 to 20	8	5.33
Very numerous	20 to 50	12	8.00
Swarming	Over 50	11	7.33
Total	....	150	100.00
Absent	....	112	74.66
Present	....	38	25.33

"The experiments made during the past year confirm our last year's observations as to the presence of the *Trypanosoma* in the circulation of young and half-grown animals of this species and their almost entire absence from full-grown animals examined. This exception occurs during the wet season.

"2. Several varieties of the *Trypanosoma* have been found in the blood of bandicoots but they appear to belong to the same species.

"3. The difficulty experienced in obtaining bandicoots on the Deccan plateau militated against the attempt on our part to obtain a complete knowledge of the conditions of the blood of these animals during each month of the year. But it is more than probable from our present knowledge that the same changes with regard to the *Trypanosoma* during the dry and wet seasons occur in the circulation of bandicoots as those detailed as observed in the rat.

"4. Nematode worms, varying in numbers and dimensions (one-half to 5 inches in length) were found in the stomachs of bandicoots, in many instances completely distending the organs. In a total of 150 animals examined, nematodes were found in 90, or 60 per cent.

"5. The livers of these animals were also the seat of extensive changes caused by the presence of vast numbers of nematode eggs, some of which mature 'in situ,' and frequently the young worms escape into the peritoneal cavity.

"6. The chief pathological changes observed were ulceration (sometimes extensive) of the villous portion of the stomach, and, as an effect of the former, the formation of diverticula, the walls of the sac being formed of thickened peritoneum extravasations of blood under the submucous tissues, enlarged spleen (4 or 5 times normal), and less frequently abscess of liver, spleen, and subcutaneous tissues.

"7. As in the case of pregnant rats, so in that of pregnant bandicoots; although the *Trypanosoma* was present in vast numbers in the blood of the mother, in no instance has it been discovered in the circulation of the fetus.

"8. The blood of the majority of bandicoots during the rainy season was found to contain an exceedingly minute spirillum, even when the *Trypanosoma* was absent from their circulation. Rabbits and guinea pigs inoculated subcutaneously with blood containing this organism contracted the disease, and death resulted in the majority of instances.

INOCULATION OF ANIMALS WITH BANDICOOTS' BLOOD.

"1. The donkey proved refractory to the *Trypanosoma* of the bandicoot, although blood teeming with the organism was on numerous occasions subcutaneously injected.

"2. Except in one instance, when the hematozoon appeared on the fourth day after inoculation, and death occurred on the forty-first day, guinea pigs generally proved refractory to the soiled blood of the bandicoot. The same applies to rabbits.

"3. Rabbits and guinea pigs acquired no resistance even to the least virulent type of surra, when subcutaneously injected daily for varying periods, with large quantities of full-grown bandicoots' blood, *sine* hematozoon."

[*Trypanosoma Theileri* Laveran, 1902, pp. 512–514, in Transvaal cattle, appeared too late to be included in this article.]

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For the benefit of Government officials, I have indicated the Governmental libraries where the works in question may be consulted, as follows:

W^a. Library of the United States Department of Agriculture.
W^c. Library of Congress.
W^m. Library of the Surgeon-General's Office.
W^s. Library of the Smithsonian Institution.

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[*Tripanosoma sanguinis*, p. 397; *T. Balbianii*, p. 398; *Trichomonas sanguinis*=*Tripanosoma*, p. 399.]

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[Identifies parasite of surra with that of rat; *Mus decumanus* and *M. rattus* (?) found infected; *M. bandicottus* and *Sorex* sp. not infected; in pregnant females, fetus not infected; increase of leucocytes; experiments with rat, dog, cat, monkey, horse, rabbit; general discussion.]

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[Excellent article; geographical distribution; definition; symptoms; postmortem appearances; mortality; contagion and infection; believes flies may carry the disease; different animals affected—horse, mule, camel; remote causes; prevention; cure; no confidence in carbolic acid; the parasite; history of individual cases, with accounts of treatment and tables of pulse, temperature, and urine.]

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1844b.—On a new species of Hæmatozoon, *Trypanosoma sanguinis*. [Transl. of Gruby, 1843] <Ann. Mag. Nat. Hist., Lond., v. 13 (82), Feb., pp. 158-159. [W^{a}.]

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1891.—The etiology of surra. [Criticism of Ranking, 1891a] <Vet. J., Lond., v. 33, Oct., pp. 309-310. [W^{a}.]

Hassall, Albert.

1902.—Bibliography of surra and allied trypanosomatic diseases <Bull. No. 42, Bureau Animal Indust., U. S. Dept. Agric., Wash., pp. 131-148. [W^{a}.]

Hayes, M. H.

1898.—Surra. (*In* Friedberger and Fröhner's Veterinary Pathology. Infective Diseases of Animals. Translated and edited by M. H. Hayes, with notes on Bacteriology by G. Neumann. 8°. London.) [W^{a}.]

[Pp. 477-487, chapter on surra, written by Hayes and based largely on Lingard.]

Hérouard, Edgard. *See* Delages, Yoes, & Hérouard, Edgard.

Jolyet, F., & de Nabias, B.

1891.—Sur un hématozoaire du lapin domestique <J. de méd. de Bordeaux, v. 20 (31), 1 mars, pp. 325-326. [W^{m}.]

Kanthack, A. A., Durham, H. E., & Blandford, W. F. H.

1898a.—On nagana or tsetse fly disease. (Report made to the tsetse fly committee of the Royal society of observations and experiments carried out from November, 1896, to August, 1898) <Proc. Roy. Soc. Lond. (Nov., 1898–Mar., 1899), v. 64 (404), Nov. 19, pp. 100–118. [W^{m}.]

1898b.—Nagana or tsetse fly disease. [Review of Kanthack, Durham, & Blandford, 1898a] <Brit. M. J., Lond. (1980), Dec. 10, pp. 1768–1769. [W^{a}.]

1898c.—Ueber Nagana oder die Tse-tse Fliegenkrankheit. [Transl. of Kanthack, Durham, & Blandford, 1898a, by G. H. F. Nuttall] <Hyg. Rundschau, Berl., v. 8 (24), 15. Dec., pp. 1185–1202, 1 fig. [W^{a}, W^{m}.]

1898d.—Idem [abstracted] <J. Comp. Path. & Therap., Edinb. & Lond., v. 11 (4), Dec. 31, pp. 370–380. [W^{m}.]

1899a.—Tsetse disease in mammals <Proc. Fourth Internat. Cong. Zool., Cambridge (22–27 Aug., 1898), Lond., pp. 166–168. [Lib. Stiles.]

[Practically the same as Durham, 1898, pp. 535–538.]

1899b.—On nagana or tsetse fly disease <Veterinarian, Lond., v. 72 (853), Jan., pp. 1–11; (854), Feb., pp. 68–79. [W^{a}.]

[Same as Kanthack, Durham, & Blandford, 1898a.]

Kempner, Walter. *See* Rabinowitsch, Lydia, & Kempner, Walter.

Kent, W. Saville.

1880.—A manual of the Infusoria, including a description of all known flagellate, ciliate, and tentaculiferous Protozoa, British and foreign, and an account of the organization and affinities of the sponges. Pts. 1–3, pp. 1–432, pls. 1–24. 8°. London. [W^{m}.]

[*Trypanosoma*, pp. 218–220.]

Kinyoun, J. J. *See* Smith, Allen M., & Kinyoun, J. J.

Koch, Robert.

1881.—Zur Untersuchung von pathogenen Organismen <Mitth. a. d. k. Gsndhtsamte, Berl., v. 1, pp. 1–42, pls. 1–14. [W^{a}.]

1898a.—"Reise-Berichte über Rinderpest, Bubonenpest in Indien und Afrika, Tsetse- oder Surrakrankheit, Texas-Fieber, tropische Malaria, Schwarzwasserfieber." 136 pp., 10 figs. 8°. Berlin. [W^{m}.]

1898b.—Report on the surra disease <Brit. M. J., Lond., v. 1 (1945), Apr. 9, p. 983. [W^{a}.]

[Brief reference to Koch's report from Dar-es-Salam; mules and ordinary donkeys subject to surra, but masai donkeys are apparently immune.]

Kruse, W.

1896.—Systematik der Protozoen. (*In Flügge's* Die Mikroorganismen. Mit besonderer Berücksichtigung der Ätiologie der Infektionskrankheiten. 3. ed., pt. 2, pp. 601–700, figs. 128–153.) [W^{m}.]

[*Trichomonas columbarum*, *T. intestinalis*, *T. vaginalis*, pp. 629–632.]

Künstler, G.

1883.—Recherches sur les Infusoires parasites. Sur quinze Protozoaires nouveaux <Compt. rend. Acad. d. sc., Par., v. 97, 2. semestre (14), 1 oct., pp. 755–757. [W^{a}, W^{m}.]

Labbé, Alphonse.

1891.—Note sur un nouveau parasite du sang (*Trypanomonas Danilewskyi*) <Bull. Soc. zool. de France, Par., v. 16, oct., pp. 229–231. [W^{a}.]

Laboulbène, A.

1888.—Sur une mouche tsé-tsé de l'Afrique australe <Bull. Acad. de méd., Par., An. 52, 2. s., v. 19 (22), 4 juin, pp. 721–724. [W^{m}.]

de Lacerda, J. B.

1885.—Pathogenesia comparada. Peste de Cadeiras ou epizootia de Marajó suas analogias com o Beriberi. viii + 98 pp. 3 pls., 2 phot. 8°. Rio de Janeiro. [W^{m}.]

de Lanessan, J. L.

1882a.—Manuel d'histoire naturelle médicale. Pt. 3, Zoologie, 728 pp., 523 figs. 12°. Paris. [W^{a}.]

[P. 71, fig. 60, brief mention of *Undulina ranarum*.]

1882b.—Traité de zoologie, Protozoaires. vii + 336 pp., 281 figs. 8°. Paris. [W^{a}.]

[Pp. 166–167, fig. 142, brief reference to "*Trypanosoma sanguinis* Gruby" and *Trypanosoma Eberthi*.]

Lankester, E. Ray.

1871.—On *Undulina*, the type of a new group of Infusoria <Quart. J. Micr. Sc., Lond., n. s., v. 11 (44), Oct., pp. 387–389, figs. 1–4. [W^{m}.]

[Living parasites found in frog's blood described as *Undulina ranarum*.]

1882.—On *Drepanidium ranarum*, the cell-parasite of the frog's blood and spleen (Gaule's Würmschen) <Quart. J. Micr. Sc., Lond., n. s., v. 22 (85), Jan., pp. 53–65, figs. 1–5. [W^{m}.]

Laveran, Alphonse. (*See also* Laveran, Alphonse, & Mesnil, F.)

1892.—Des Trypanosomes parasites du sang <Arch. de méd. expér. et d'anat. path., Par., 1. s., v. 1 (2), 1 mars, pp. 257–269, pl. 1. [W^{a}, W^{m}.]

1893.—Paludism. xii + 197 pp., 7 figs., 6 pls. 8°. London. [W^{a}.]

1895.—Les Hématozoaires de l'homme et des animaux. Pt. 1, Protozoaires du sang, iv + 154 pp., 9 figs. Paris. [Lib. Stiles.]

[Account of *Trypanosoma* in various animals, pp. 129–149.]

Laveran, Alphonse, & Mesnil, F.

1900a.—De la longue conservation à la glacière des Trypanosomes du rat et de l'agglomération de ces parasites <Compt. rend. Soc. de biol., Par., v. 52 (29), 12 oct., pp. 816–819. [W^{a}.]

[Describes agglutination.]

1900b.—Sur l'agglutination des Trypanosomes du rat par divers sérums <Compt. rend. Soc. de biol., Par., v. 52 (34), 16 nov., pp. 939–942. [W^{a}.]

[Experimented with serum of dog, rabbit, sheep, horse, chicken, pigeon, rat.]

1901a.—Sur le mode de multiplication du Trypanosome du nagana <Compt. rend. Soc. de biol., Par., v. 53 (12), 29 mars, pp. 326–329. [W^{a}.]

[Description and figures of division.]

1901b.—Sur la nature centrosomique du corpuscule chromatique postérieur des Trypanosomes <Compt. rend. Soc. de biol., Par., v. 53 (12), 29 mars, pp. 329–331. [W^{a}.]

[Homologous with the attractive spheres of *Noctiluca* and centrosomes of spermatoids.]

1901c.—Sur la structure du Trypanosome des grenouilles et sur l'extension du genre *Trypanosoma* Gruby <Compt. rend. Soc. de biol., Par., v. 53 (23), 28 juin, pp. 678–680, figs. 1–3. [W^{a}.]

[Genus *Herpetomonas* is discarded.]

1901d.—Sur la morphologie et la systématique des Flagellés à membrane ondulante (genres *Trypanosoma* Gruby et *Trichomonas* Donné) <Compt. rend. Acad. d. sc., Par., v. 133 (3), 15 juillet, pp. 131–137, figs. 1–5. [W^{a}.]

[General discussion; important.]

LAVERAN, ALPHONSE, & MESNIL, F.—Continued.

1901e.—Recherches morphologiques et expérimentales sur le Trypanosome des rats (*Tr. Lewisi* Kent) <Ann. de l'Inst. Pasteur, Par., v. 15 (9), 25 sept., pp. 673–714, pls. 11–12. [W^{a}.]

[Very important paper.]

1901f.—Sur la nature bactérienne du prétendu Trypanosome des huîtres (*Tryp. Balbianii* Certes) <Compt. rend. Soc. de biol., Par., v. 53 (31), 25 oct., pp. 883–885. [W^{a}.]

[*Trypanosoma Balbianii* does not belong to the genus *Trypanosoma.*]

1901g.—Sur les Flagellés à membrane ondulante des poissons (genres *Trypanosoma* Gruby et *Trypanoplasma* n. gen.) <Compt. rend. Acad. d. sc., Par., v. 133 (18), 28 oct., pp. 670–675. [W^{a}.]

[Three new species.]

1902a.—Recherches morphologiques et expérimentales sur le Trypanosome du nagana ou maladie de la mouche tsétsé <Ann. de l'Inst. Pasteur, Par., v. 16 (1), 25 jan., pp. 1–55, figs. [W^{a}.]

1902b.—Study of the *Trypanosoma* of tsetse fly disease. [Abstract of Laveran & Mesnil, 1902a] <J. Am. M. Ass., Chicago, v. 38 (11), Mar. 15, p. 738. [W^{a}.]

1902c.—Morphological and experimental researches on *Trypanosoma* of rats (*T. Lewisi*). [Review of Laveran & Mesnil, 1901e] <Exp. Sta. Rec., U. S. Dept. Agric., Wash., D. C., v. 13 (6), p. 532. [W^{a}.]

LECLER, M.

1899.—El mal de caderas (contribucion al estudio de esta enfermedad). 15 pp. 4°. Buenos Aires. [W^{a}.]

LECLERCQ, EMMA.

1890.—Les microorganismes intermédiaires aux deux règnes <Bull. Soc. belge de Micr., Brux., v. 16 (8), pp. 70–131, figs. 1–7. [W^{m}.]

LEES, KAY.

1888.—*Glossina morsitans* or tsetse fly <Vet. J. & Ann. Comp. Path., Lond., v. 27, Aug., pp. 79–84. [W^{m}.]

[Claims to have found the tsetse fly in India, Naga Hills; heavy losses in transport service; quotes Dr. Livingstone's observations on the tsetse fly.]

LEWIS, TIMOTHY RICHARDS.

1878.—The microscopic organisms found in the blood of man and animals, and their relation to disease <14th Ann. Rep. San. Com. India, Calcutta (1877), Appendix B, pp. 157–208, figs. 1–27, pls. 1–3. [W^{m}.]

1879.—Flagellated organisms in the blood of healthy rats <Quart. J. Micr. Sc., Lond., n. s., v. 19 (73), Jan., pp. 109–114, 1. fig. [W^{m}.]

1884.—Further observations on flagellated organisms in the blood of animals. <Quart. J. Micr. Sc., Lond., n. s., v. 24 (96), July, pp. 357–369, figs. 1–5. [W^{m}.]

1888.—Flagellated organisms in the blood of animals. (*In* Physiological and pathological researches; being a reprint of the principal scientific writings of the late Timothy Richards Lewis. Arranged and edited by William Aitken, G. E. Dobson, and A. E. Brown. 8°. London. pp. 604–609.) [W^{m}.]

LINGARD, ALFRED.

1893.—Report on horse surra. v. 1, 125+cclxxix pp., 11 pls. fol. Bombay. [W^{a}.]

[Exceedingly important medical discussion; most extensive paper on surra in print].

Lingard, Alfred—Continued.

1894a.—Summary of further report on surra. 8 pp. fol. Bombay. [W^a.]

1894b.—Idem <Vet. J., Lond., v. 39 (232), Oct., pp. 250–258; (233), Nov., pp. 311–315. [W^m.]

1894c.—The disease surra in solipeds and camels. [Review of Lingard, 1893] <Vet. J., Lond., v. 38, Mar., pp. 172–175. [W^a.]

1895.—Summary of further report on surra. 13 pp. fol. Bombay. [W^a.]

1896.—Annual report of the imperial bacteriologist for the official year 1895–96. 61 pp., 1 map. 4°. Bombay. [W^a.]

1898a.—Annual report of the imperial bacteriologist for the official year 1896–97. iii+77 pp. fol. [Calcutta.] [W^a.]

1898b.—Surra report. Appendices, including records of cases, charts, and illustrations. v. 2, pt. 2, 230 pp., 3 pls. fol. Bombay. [W^a.]

1899.—Report on surra in equines, bovines, buffaloes, and canines, together with an account of experiments conducted with the *Trypanosoma* of rats, bandicoots, and fish. v. 2, pt. 1, ii+160 pp., pls. 1–2. fol. Bombay. [W^a.]

[Very important.]

1900.—Report on surra, disease in horses. [Review of Lingard, 1899] <Vet. J., Lond., n. s., v. 2 (11), o. s., v. 51 (305), Nov., pp. 340–345. [W^a.]

1901.—Report on surra in equines, bovines, buffaloes, and canines, etc. [Review of Lingard, 1899, by Railliet] <Rec. de méd. vét., Par., 8. s., v. 8, 15. juin, pp. 377–378. [W^a.]

Livingston, David.

1858a.—The tsetse. (*In his* Missionary travels and researches in South Africa, including a sketch of sixteen years' residence in the interior of Africa and a journey from the Cape of Good Hope to Loanda on the west coast, thence across the continent, down the river Zambesi to the eastern coast. 8°. New York. pp. 93–97, 612–613, figs. 1–3.) [W^a.]

1858b.—Arsenic as a remedy for the tsetse bite <Brit. M. J., Lond., n. s. (70), May 1, pp. 360–361. [W^m.]

Lühe, Max.

1900a.—Ergebnisse der neueren Sporozoenforschung. Zusammenfassende Darstellung, mit besonderer Berücksichtigung der Malaria-Parasiten und ihrer nächsten Verwandten <Centralbl., f. Bakteriol., Parasitenk. [etc.], Jena, 1. Abt., v. 27 (10–11), 23. März, pp. 367–384, figs. 1–9; (12–13), 31. März, pp. 436–460, figs. 1–9; v. 28 (6–7), 22. Aug., pp. 205–209; (8–9), 4. Sept., pp. 258–264, figs. 1–6; (10–11), 20. Sept., pp. 316–324, figs. 7–10; (12–13), 6. Okt., pp. 384–392. [W^a.]

[*Trypanosoma*, p. 443.]

1900b.—Ergebnisse der neuern Sporozoen-Forschung. Zusammenfassende Darstellung mit besonderer Berücksichtigung der Malariaparasiten und ihrer nächsten Verwandten. iv + 100 pp., 35 figs. 8°. Jena. [W^a.]

[Reprint of Lühe, 1900a, with additions.]

de Lustrac, A.

1896.—*Trypanosoma Balbianii*, Certes <Actes Soc. Linn. de Bordeaux, v. 50, 5. s., v. 10, pp. 265–275, pls. 1–2. [W^c.]

McWeeney, E. J.

1899.—Reports on recent bacteriological and hygienic researches. II. Koch's work on the plague in Africa, tsetse fly disease, and Texas fever <J. State M., Lond., v. 7 (2), Feb., pp. 115–120. [W^m.]

MALKMUS, BERNARD.

1901.—**Outlines of clinical diagnostics of the internal diseases of domestic animals, translated from the latest German edition by D. S. White & Paul Fischer.** 205 pp., 45 figs. 8°. Chicago. [W^{c}.]

MAROTEL, G.

1902.—**Les hématozoaires et leurs modes de transmission** <J. de méd. vét. et zootech., Lyon, 5. s., v. 6, 28 fév., pp. 97-107. [W^{a}.]

MARSHALL, W.

1885.—**Ueber die Tsetsefliege** <Biol. Centralbl., Erlang., v. 5 (6), 15. Mai, pp. 183-184. [W^{m}.]

[MAUS, L. M.]

1902.—**A new epidemic disease among horses in the Philippine Islands** <Phila. M. J., v. 9 (4), Jan. 25, p. 149. [W^{a}.]

MAXWELL, THOMAS.

1857.—**On "surrah"** <Indian Ann. M. Sc., Calcutta, v. 4, Apr., pp. 441-447. [W^{m}.]

MAYER, A. F. I. CAROLUS.

1843.—**Specilegium observationum anatomicarum de organo electrico in Raiis anelectricis et de Hæmatozois.** 17 pp., 3 pls. 4°. Bonnæ. [W^{a}.]

MED. REC., N. Y.

1902a.—**Surra among the army mules in the Philippines** <Med. Rec., N. Y., v. 61 (6), Feb. 8, p. 221. [W^{a}.]

1902b.—**Treatment and prevention of "surra" in horses, mules and other animals.** [Review of circular, Jan. 11, Military Governor, Philippines] <Med. Rec., N. Y., v. 61 (11), Mar. 15, p. 420. [W^{a}.]

MÉGNIN, J. P.

1875a.—**Mémoire sur la question du transport et de l'inoculation de virus par les mouches** <J. de l'anat. et physiol. [etc.], Par., v. 11 (2), mars-avril, pp. 121-133, pl. 7. [W^{m}.]

1875b.—**Du rôle des mouches dans la propagation du charbon et autres affections virulentes** <J. de méd. vét. mil., Par., v. 12 (8), jan., pp. 461-475. [W^{m}.]

[Tsétsé, pp. 471 ff.]

MESNIL, F. *See* Laveran, Alphonse, & Mesnil, F.

MITROPHANOW, P.

1883.—**Beiträge zur Kenntniss der Hämatozoen. Neue monadenförmige Parasiten des Fischbluts, ihnen ähnliche Organismen und ihre Beziehung zu den Blutelmenten** <Biol. Centralbl., Erlang., v. 3 (2), 15. März, pp. 35-44, figs. 1-2. [W^{m}.]

MÖBIUS, K.

1883.—*Trypanosoma Balbianii* Certes im Krystallstiel schleswig-holsteinischer Austern <Zool. Anz., Leipz., v. 4 (134), 19. März, p. 148. [W^{m}.]

DE NABIAS, B. *See* Jolyet, F., & de Nabias, B.

NARIMAN & VAZ.

1893.—The disease "surra" <Vet. J., Lond., v. 36, June, pp. 403-406. [W^{a}.]

[No practical treatment found; excrements and breath highly offensive; sporadic cases in every season throughout the year; communicable to all species of domesticated animals (mammals); temperature in febrile attack 104° to 106° F.; symptoms; diagnosis; post-mortem appearances; treatment, inhalations of carbolic acid, 1 oz., in closed room, or hypodermic injections, 2 grains corrosive sublimate in a solution with common salt.]

NEPVEU, G.

1898.—Sur un Trypanosome dans le sang de l'homme <Compt. rend. Soc. de biol., Par., 10. s., v. 5 (41), 30 déc., pp. 1172–1174. [W^a.]

[Gives an alleged occurrence of *Trypanosoma* in man; description incomplete.]

NEUMANN, L. G.

1888.—Traité des maladies parasitaires non microbiennes des animaux domestiques. xv + 673 pp., 306 figs. 8°. Paris. [W^a.]

[Pp. 33–34, brief reference to tsetse fly, with quotation on the disease taken from Railliet; p. 557, brief reference to Künstler, 1883, p. 775.]

1892a.—Idem. 2. éd. xvi + 767 pp., 364 figs. 8°. Paris. [W^a.]

[Pp. 35–36, brief account of the tsetse fly, copied from Railliet; p. 631, brief reference to *Trypanosoma* in rabbit (Jolyet & de Nabias, 1891), and guinea pig (Künstler, 1883); p. 626 mentions *Trypanosoma sanguinis avium* of Danilewsky.]

1892b.—A treatise on the parasites and the parasitic diseases of the domesticated animals, translated and edited by George Flemming. xxiii, + 800 pp., 364 figs. 8°. London. [W^a.]

[Pp. 34–36, brief account of tsetse fly, copied from Railliet; p. 619–622, surra; p. 635, *Trypanosoma* in rabbit (Jolyet & de Nabias, 1891), and in guinea pig (Künstler, 1883); p. 649 mentions *Trypanosoma sanguinis avium* of Danilewsky.]

NOCARD.

1901a.—Sur les rapports qui existent entre la dourine et le surra ou le nagana <Compt. rend. Soc. de biol., Par., v. 53 (16), 10 mai, pp. 464–466. [W^a.]

1901b.—Idem [reviewed] <Rec. de méd. vét., Par., 8. s., v. 8 (11), 15 juin, pp. 379–380. [W^a.]

NOCKOLDS, COLEMAN.

1901.—"Surra" in the Philippines <Am. Vet. Rev., N. Y., v. 25 (9), Dec., pp. 743–745. [W^a.]

1902.—Some further remarks on "surra" <Am. Vet. Rev., N. Y., v. 25 (11), Feb., pp. 900–903. [W^a.]

NUTTALL, GEORGE H. F.

1898.—Neuere Untersuchungen über Malaria, Texasfieber und Tsetsefliegenkrankheit. Zusammenfassender Bericht <Hyg. Rundschau, Berl., v. 8 (22), 15. Nov., pp. 1084–1102. [W^a.]

[An excellent digest of recent literature.]

1899.—Die Rolle der Insekten, Arachniden (*Ixodes*) und Myriapoden als Trägen bei der Verbreitung von durch Bakterien und thierische Parasiten verursachten Krankheiten des Menschen und der Thiere. Eine kritisch-historische Studie <Hyg. Rundschau, Berl., v. 9 (5), 1. März, pp. 209–220; (6), 15. März, pp. 275–289; (8), 15. Apr., pp. 393–408; (10), 15. Mai, pp. 503–520; (12), 15. Juni, pp. 606–620. [W^a.]

[An excellent critical digest of subject indicated in title; extensive bibliography; this paper should be read by all interested in the subject.]

OSBORN, HERBERT.

1896.—Insects affecting domestic animals; an account of the species of importance in North America, with mention of related forms occurring on other animals. Bull. No. 5, n. s., U. S. Dept. Agric., Div. Entom., 302 pp., 170 figs. 8°. Washington, D. C. [W^a.]

[Pp. 133–134, brief mention of the tsetse fly.]

Osler, William.

1887.—An address on the hæmatozoa of malaria <Brit. M. J., Lond., v. 1 (1367), Mar. 12, pp. 556–562, figs. 1–15. [W^{a}.]

[Refers to the work of Evans, Steel, Lewis, Crookshank, Mitrophanow, and Danilewsky on surra and *Trypanosoma.*]

Oswell, W.

1852.—Sur une mouche venimeuse de l'Afrique méridionale <Compt. rend. Acad. d. sc., Par., v. 35 (16), 2. sémestre, pp. 560–561. [W^{a}.]

1853.—Giftige Fliege in Süd-Africa. [Review of Oswell, 1852] <Repert. d. Thierh., Stuttg., v. 14, p. 367. [W^{m}.]

Pease, H. J.

1897.—Surra and malarial fever <Veterinarian, Lond., v. 70 (838), Oct., pp. 549–565, figs. [W^{a}.]

[Caustic criticism of Burke, 1897; general discussion of surra, comparing it with other diseases.]

Penning, C. A.

1900a.—Verdere Waarnemingen betreffende Surra in Nederl.-Indië <Veearts. Bladen v. Nederl.-Indië, Batavia, v. 13 (1), Mai, pp. 25–52, pl. 1. [W^{a}.]

1900b.—Verdere Waarnemingen betreffende Surra in Ned.-Indië. [Review of Penning, 1900a, by Tjaden] <Centralbl. f. Bakteriol., Parasitenk. [etc.], Jena, 1. Abt., v. 28 (18), 17. Nov., pp. 613–614. [W^{a}.]

Pfeiffer, L.

1889.—Beiträge zur Kenntniss der pathogenen Gregarinen. III. Ueber Gregarinose, ansteckendes Epitheliom und Flagellaten-Diphtherie der Vögel <Ztschr. f. Hyg., Leipz., v. 5 (3), 31. Jan., pp. 363–401, figs. 1–15, pl. 3. [W^{a}.]

Plimmer, H. G., & Bradford, J. Rose.

1899a.—A preliminary note on the morphology and distribution of the organism found in the tsetse fly disease <Veterinarian, Lond., v. 72 (861), Sept., pp. 648–657. [W^{a}.]

[Reprinted from Nature. Description of adult *Trypanosoma Brucii;* distribution of parasite in body; infectivity, life history.]

1899b.—Vorläufige Notiz über die Morphologie und Verbreitung des in der Tsetsekrankheit ("Fly Disease" oder "Nagana") gefundenen Parasiten. [Transl. of Plimmer & Bradford, 1899a] <Centralbl. f. Bakteriol., Parasitenk. [etc.], Jena, 1. Abt., v. 26 (14–15), 28. Okt., pp. 440–447. [W^{a}.]

[Description of "*Trypanosoma Brucii;*" its distribution in the body; blood of dead animals loses power of infection twenty-four hours after death; life cycle of parasite.]

Rabinowitsch, Lydia, & Kempner, Walter.

1899.—Beitrag zur Kenntniss der Blutparasiten, speciell der Rattentrypanosomen <Ztschr. f. Hyg., Leipz., v. 30 (2), 18. Apr., pp. 251–294, pl. 2. [W^{a}.]

[Review of literature; morphology and development; longitudinal and transverse division; segmentation; infection experiments; active and passive immunity; infection by fleas.]

Railliet, Alcide.

1884.—Du rôle de la tsétsé dans la propagation des maladies <Bull. Soc. centr. de méd. vét., Par., v. 38, n. s., v. 2, pp. 79–80. [W^{a}.]

[*Glossina morsitans,* probably a carrier of infectious material rather than a poisonous insect.]

1893.—Traité de zoologie médicale et agricole. v. 1, 736 pp., 494 figs. 8°. Paris. [W^{a}.]

1895.—Idem. v. 2, pp. 737–1303, figs. 495–892. 8°. Paris. [W^{a}.]

[Pp. 787–788, *Glossina morsitans* and nagana, brief general discussion.]

RANKING, GEORGE.

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THE SIGNIFICANCE OF THE RECENT AMERICAN CASES OF HOOKWORM DISEASE (UNCINARIASIS, OR ANCHYLOSTOMIASIS) IN MAN.[a]

By Ch. Wardell Stiles, Ph. D.,
Zoologist of Bureau of Animal Industry.

(Figures 113 to 196.)

INTRODUCTION.

There is nothing strange in the fact that a number of cases (about 35 since 1893) of uncinariasis in man have recently been diagnosed in this country. It is, on the contrary, strange that this disease has not been found more frequent and more general. Uncinariasis is common, in certain parts of the country, in dogs, cattle, and sheep, and from this fact we may conclude that the physical conditions are present which are necessary to the development of the congeneric parasite which affects man. Further, even if we assume that the malady in question was not here twenty years ago, so many immigrants have come to the United States during the past twenty years from countries in which the disease is more or less common that it is difficult to see how we could possibly expect the country to remain free from infection. The indications are that the disease is already more or less widespread and that it is here to stay; further, that not a few cases of obscure but extreme anemia with which some physicians have been dealing have been uncinariasis; and that the failure to recognize the exact nature of the disease has been due purely and simply to the fact that, taking the country at large, it is the exception rather than the rule that practitioners make a microscopic examination of the stools of their patients, even in the case of young children.[b]

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[a] This article has been prepared in response to a request from Dr. Walter Wyman, Surgeon-General, United States Public Health and Marine-Hospital Service, for a short, concise, practical statement in regard to uncinariasis in this country, together with my opinion as to the probable spread of the disease.—C. W. S.

[b] Since the above statement was written last December, it has been found that, independent of the introduced cases caused by *Uncinaria duodenalis*, we have in America an endemic uncinariasis, due to a totally distinct species, which I have named *Uncinaria americana*. I have now examined specimens of this new parasite from Virginia, Texas, Cuba, and Porto Rico. The clinical picture of the disease does not appear to differ from that of the malady caused by the Old World parasite *U. duodenalis*. With the discovery of this new parasite, the intimation just given—namely, that uncinariasis has existed here for some time, but has not been recognized—may now be made as a positive statement.

Now that so many American soldiers who have been on extra-state service are returning home from localities where uncinariasis is known to exist, we may confidently expect an increase in this disease. It will therefore be well for practitioners to understand the more important facts concerning the malady in question. Furthermore, as soon as work is advanced on "the canal," whether it be in Panama or Nicaragua, we may expect hundreds of deaths from this malady among the laborers unless proper precautions are adopted.

In general, it may be stated that hookworm disease will be more common in the South than in the North; more common in the summer and fall than in the winter and spring; and more prevalent in moist districts than in dry. It may also be stated that the amount of active infection in nature (outside of the bodies of the patients) will increase with warmth and moisture, but will decrease with dryness and cold. Freezing, fire, or desiccation will kill the free infection, active or latent.

DEFINITION.

Uncinariasis is a specific zooparasitic disease caused by hookworms (genus *Uncinaria*) which inhabit the small intestine. Its chief symptoms are: Anemia, with the circulatory symptoms found in all extreme anemias, namely, dizziness, palpitation, hemic murmurs; colicky pains in the abdomen; great weakness, in some cases with considerable emaciation; constipation or diarrhea, stools sometimes brownish or bloody; nausea; edema. The only positive diagnosis is by finding the parasite or its eggs in the stools. It may affect any class of patients, but is more frequent in persons whose daily life brings them in contact with damp earth (miners, brickmakers, excavators, dirt eaters, etc.).

TERMINOLOGY.

The disease now under discussion is known by a number of different names, but *uncinariasis*[a] or *uncinariosis* should be adopted as the more correct technical designation. Among the names frequently applied to it, the following may be mentioned in particular: Anchylostomiasis, ankylostomiasis, brickmakers' anemia, Egyptian chlorosis, miners' anemia, miners' cachexia, Porto Rican anemia, St. Gothard tunnel disease, tropical chlorosis, tunnel anemia, hookworm disease, and tunnel disease.

---

[a] Looss (1902) has recently attempted to suppress the term uncinariasis in favor of anchylostomiasis, his view being that the genus *Agchylostoma* is distinct from *Uncinaria*. His suggestion does not help matters much at present. Even if the zoological genera were recognized as distinct, uncinariasis would still exist in man, while among animals it would be more common than anchylostomiasis. Further, the two genera would have to be united in a subfamily, which could best be called Uncinariinæ, and uncinariasis could then signify any infection of any animal with any member of this subfamily. In case the term anchylostomiasis is adopted, which of the many spellings should be recognized? Adopting uncinariasis relieves us of the necessity of discussing that point.

The case at hand gives rise to the question whether it is not inadvisable to name diseases after the zoological names of the parasites, at least during the transitional stage of zoological nomenclature.

ZOOLOGICAL POSITION OF THE PARASITE.

The parasite which causes uncinariasis is a worm belonging to the nematode family Strongylidæ, subfamily Strongylinæ, genus *Uncinaria*, species *Uncinaria duodenalis*.

FAMILY STRONGYLIDÆ.

Family Diagnosis.—Nematoda: With body elongate, cylindrical, rarely filiform. Mouth is probably always provided with six papillæ, of which the four submedian are generally salient in form of nodules or conical points. In some cases the mouth is in the axis of the body; in others it is turned dorsally or ventrally, and occasionally provided with a chitinous armature. Esophagus more or less swollen in posterior portion, but without forming in adults a distinct esophageal bulb. Male provided with a caudal bursa, open or closed, entire or divided, and with one or two spicules. Female with one or two ovaries; vulva anterior or posterior of equatorial plane, in some cases near the anus. Eggs deposited during segmentation, in some cases containing embryo.

Type genus.—*Strongylus* O. F. Mueller.

The sexes are separate and the digestive tract is complete. Characteristic for the family is the presence, on the tail of the male, of an umbrella-like structure known as the caudal or "copulatory bursa," supported by a number of finger-like "rays," which may be compared to the ribs of an umbrella. In copula, the male clasps the body of the female by means of this bursa.

This family is divided into subfamilies, according to the presence of certain anatomical characters. The parasite of uncinariasis belongs to the subfamily Strongylinæ,[a] which, as its former name, Sclerostominæ, indicated, is characterized by the presence of a hard chitinous "buccal capsule."

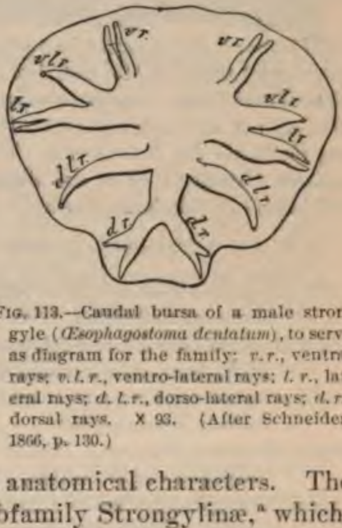

Fig. 113.—Caudal bursa of a male strongyle (*Œsophagostoma dentatum*), to serve as diagram for the family: *v. r.*, ventral rays; *v. l. r.*, ventro-lateral rays; *l. r.*, lateral rays; *d. l. r.*, dorso-lateral rays; *d. r.*, dorsal rays. × 93. (After Schneider, 1866, p. 130.)

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[a] From a study of the history of the nematode genera, it is very clear that there will have to be a general revision of the technical names of this group. The original *Strongylus*, for instance, was a sclerostome, hence the names *Sclerostoma* and Sclerostominæ will have to fall into synonymy. It is probable that *Metastrongylus* will be the correct name for the lung strongyles. The types of several genera must be established before the correct names can be determined for the groups represented by *Strongylus contortus* and *Strongylus ventricosus*. As soon as certain remaining points of this nature are decided, Hassall and I will issue a list of nematode genera, together with their type species.

Subfamily Strongylinæ.

Subfamily diagnosis.—Strongylidæ: Meromyaria; mouth with more or less complete chitinous armature. Male with two equal spicules; caudal bursa with rays, the dorsomedian and dorsolateral being united in a common base. Female with two ovaries, except in *Ollulanus*.

Type genus.—*Strongylus* Mueller.

The subfamily Strongylinæ is in turn divided into a number of genera, of which we may mention here the following:

Strongylus [*Sclerostoma*]; the sclerostomes, including the colic worms of horses and the kidney worms of hogs (but not the kidney worms of dogs and man);

Syngamus, including the gape worms of chickens; and

Uncinaria,[a] the hookworms, including the parasite of uncinariasis.

Genus Uncinaria[b] Frölich, 1789.

Generic diagnosis.—Strongylinæ: With anterior extremity curved dorsally; mouth round to oval, opening oblique, limited by a transparent border and followed by a chitinous buccal capsule; the dorsal portion of the capsule is shorter than the ventral, and is supported by a conical structure, the point of which sometimes extends into the cavity; at the base of the buccal capsule are found two ventral teeth; toward the inner free border the ventral wall bears on each side of the median line chitinous structures, lips or teeth, often recurved in shape of hooks; the inner dorsal wall may also bear lips or teeth. Oviparous, eggs with thin, transparent shell.

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[a] Should Looss's view prove correct (as seems quite probable) that *Agchylostoma* and *Uncinaria* are generically distinct, then *Agchylostoma duodenale* will probably be the correct name of the Old World hookworm, and *Uncinaria americana* that of the New World form. Under no circumstances should *U. americana* be spoken of as a *Dochmius* or an *Agchylostoma*, and it is in the interest of conservatism at present to use *Uncinaria* for both forms. The points at issue will have to be decided upon basis of a study of all of the allied species. I am now engaged upon such a study and hope to publish the results in the near future.

[b] Synonymy, with Original Place of Publication.

1789: *Uncinaria* Frölich<Der Naturforscher, Halle, v. 24, pp. 137–139; type, *Uncinaria vulpis* Frölich, 1789.

1843: *Agchylostoma* Dubini<Annal. univers. di medic., Milano, v. 106, aprile, pp. 5–13; type, *Agchylostoma duodenale* Dubini, 1843.

1845: *Ancylostoma* Creplin<Archiv f. Naturg., Berlin, 11. J., v. 1, p. 325; for *Agchylostoma* Dubini, 1843.

1845: *Dochmius* Dujardin, Histoire naturelle d. helminthes, pp. 267, 275–279; type, *Uncinaria vulpis* Frölich, 1789.

(1846): *Anchylostoma* delle Chiaje<Rendicon. dell'Accad. delle Sci. Napoli, v. 5, p. 339. [Not verified.]

1850: *Anchylostoma* Dubini, Entozoografia umana, pp. 102–112; for *Agchylostoma* Dubini, 1843.

1851: *Ancylostomum* Diesing, Systema helminthum, v. 2, p. 82; for *Agchylostoma* Dubini, 1843.

1851: *Anchylostomum* Diesing, Systema helminthum, v. 2, pp. 321–322; for *Agchylostoma* Dubini, 1843.

1861: *Monodontus* Molin (not *Monodonta* Lamarck, 1799), Il sottordine degli acrofalli <Mem. r. Ist. ven. di sc., lett. ed arti, Venezia, v. 9, pp. 435, 463–470; type, *M. semicircularis* Molin, 1861.

1894: *Anchilostoma* Abbamondi & Cipollone<Gior. med. d. r. esercito [etc.], Roma, v. 42 (5), maggio, pp. 513–531. [Probably earlier, 1881.]

TYPE SPECIES: *Uncinaria vulpis* Frölich, 1789.

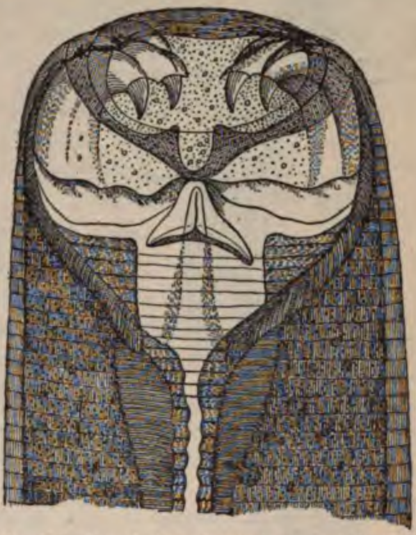
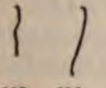


FIG. 114.—Dorsal view of anterior end of the Old World hookworm (*Uncinaria duodenalis*) of man. Greatly enlarged. (After Perroncito, 1882, p. 339, fig. 140.)

The anatomical character which distinguishes the genus *Uncinaria* is the dorsal curvature of the anterior extremity of the body, due to the shortness of the dorsal wall of the buccal capsule and resulting in bringing the mouth into a dorsal instead of a terminal or a ventral position.

In most medical writings this genus is named *Anchylostoma*, a word which is spelled in at least nine different ways, and the disease is spoken of as *anchylostomiasis*.[a] This nomenclature and terminology are due to the fact that when the worm (*Uncinaria duodenalis*) was first described in man, in 1843, it was supposed to represent a new genus (*Agchylostoma*). As a matter of fact, however, it is generally acknowledged to be congeneric with a worm described in 1789 as *Uncinaria*. By the international "law of priority," therefore, the names *Agchylostoma*, *Anchylostoma*, etc., fall into synonymy, until it can be shown that the two species are not congeneric.[b]



115. 116.

FIGS. 115-116.—Male and female hookworms (*Uncinaria duodenalis*) of man. Natural size. Original.

The hookworm of man is specifically distinct from the earlier known forms; so it retains its original specific name. The full correct technical name is *Uncinaria duodenalis*, and this should be used instead of the usually adopted combination *Anchylostoma duodenale*.[b]

In explanation to physicians it may be here stated that zoologists are obliged to deal with hundreds of thousands of technical names, and on this account they have been forced to adopt very rigid rules

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1897: *Anchylostamum* MÖHLAU<Buffalo M. J., v. 36 (8), Mar., p. 573. [Misprint for *Anchylostomum*.]

"*Ankylostoma* Dubini" and *Ankylostomum* of various authors.

[a] See footnote, p. 184.

[b] See footnotes, pp. 184, 185.

governing their use. Their most important rule is the "law of priority," which to them is as essential as is the "code of ethics" to the physician.

The genus *Uncinaria* contains blood-sucking worms of the worst type. They are usually not over an inch in length nor thicker than an ordinary hatpin. They are provided with a heavy armature of sharp teeth, by means of which they pierce the intestinal mucosa of their host. They have also an unusually strong muscular esophagus, which serves as a pump during the act of sucking blood. An important point, from the medical aspect of the parasites, is that they do not remain fastened to one spot in the bowels, but suck first at one spot and then at another. Thus the patient loses blood directly to the parasites and also, by numerous minute hemorrhages, into the intestine. It is probably this latter factor which occasionally gives to the stools of patients that peculiar brownish tinge and also their occasional bloody appearance.

The injury to the intestinal wall does not stop with the bite. The wound forms an excellent point of attack for bacteria, and the intestinal wall becomes thickened, thus losing, to a greater or lesser degree, the ability properly to perform its function. Not only does the patient lose blood, but his power of assimilation is impaired and the supply of blood-forming material is thus in part cut off. Some authors also claim that the parasites produce a poison which acts upon the system, a view which seems quite plausible.

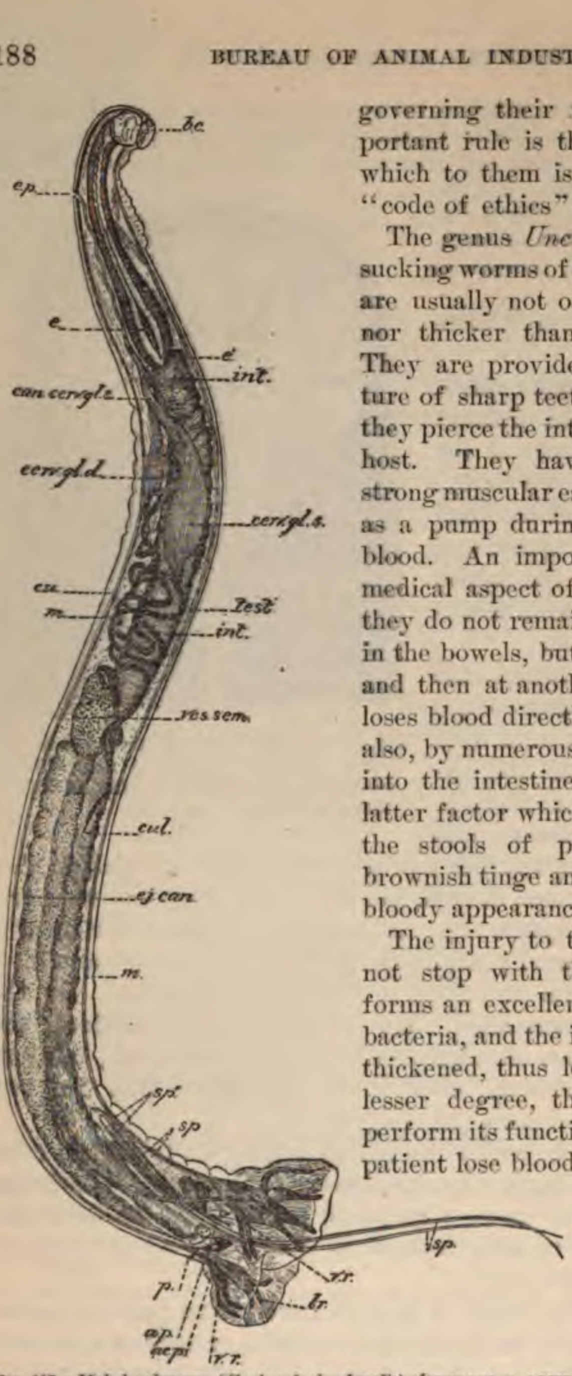

FIG. 117.—Male hookworm (*Uncinaria duodenalis*) of man: *ac. p.*, accessory piece to spicules; *a. p.*, "anal papilla;" *b. c.*, buccal capsule; *can. cerv. gl. s.*, canal of left cervical gland; *cerv. gl. d.*, right cervical gland; *cerv. gl. s.*, left cervical gland; *cu.*, cuticle; *cul.*, cul de sac of testicular tube; *e.*, esophagus; *e'*, posterior end of esophagus; *e. p.*, ventromedian excretory pore; *ej. can.*, ejaculatory canal; *int.*, intestine; *l. r.*, lateral ray of bursa; *m.*, muscular layer; *p.*, lateral præcaudal papilla; *sp.*, spicules; *sp'*, anterior end of spicules; *test.*, testicular tube; *ves. sem.*, vesicula seminalis; *v. r.*, ventral rays of bursa. Greatly enlarged. (After Schulthess [copied from Blanchard, 1888, p. 755, fig. 370].)

It was stated above that hookworms are found in various animals. Now, the general rule may be laid down that where these worms are present trouble may be expected. *Uncinaria duodenalis* causes in man the disease variously known as uncinariasis, uncinariosis, anchylostomiasis, tunnel disease, miners' anemia, brickmakers' anemia, mountain anemia, etc.

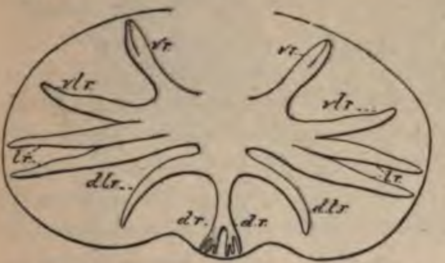

FIG. 118.—Semidiagrammatic figure of the caudal bursa of an Old World male hookworm (*Uncinaria duodenalis*) of man. (After Railliet, 1886, p. 357, fig. 247.)

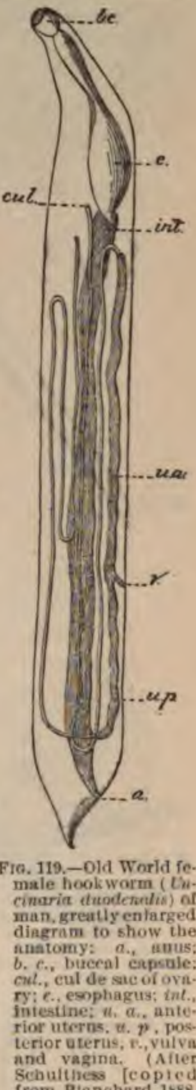

FIG. 119.—Old World female hookworm (*Uncinaria duodenalis*) of man, greatly enlarged diagram to show the anatomy: *a.*, anus; *b. c.*, buccal capsule; *cul.*, cul de sac of ovary; *e.*, esophagus; *int.*, intestine; *u. a.*, anterior uterus, *u. p.*, posterior uterus; *v.*, vulva and vagina. (After Schulthess [copied from Blanchard, 1888, p. 761, fig. 374].)

Uncinaria canina[a] causes a similar disease in dogs, resulting, in some parts of the country, in a death rate of from 25 to 40 per cent of the pups born. Uncinariasis in dogs is exceedingly common in Washington, D. C. "Thyphoid" in cats is attributed to this parasite.

Uncinaria stenocephala occurs in dogs, foxes, and allied animals, and is causing considerable trouble in the blue fox (*Vulpes lagopus*) industry.

Instructors in medical colleges who wish to demonstrate hookworms and their eggs to the students will find the species infesting dogs excellent substitutes for *Uncinaria duodenalis* of man in case the latter species can not be obtained.

Uncinaria trigonocephala[b] is found in sheep and produces a serious anemia. This parasite has been met in Victoria and Calhoun counties, Tex., where, in conjunction with the twisted wireworm (*Strongylus contortus*), it has caused the death of from 25 to 50 per cent of certain flocks.

Uncinaria radiata[c] is found in cattle, producing

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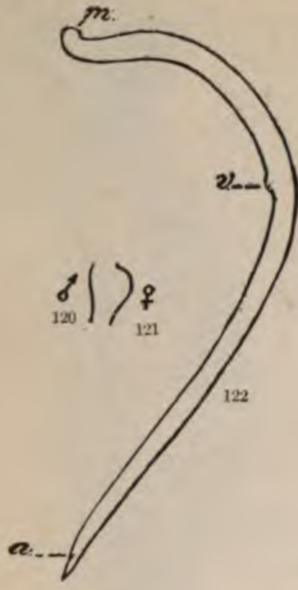
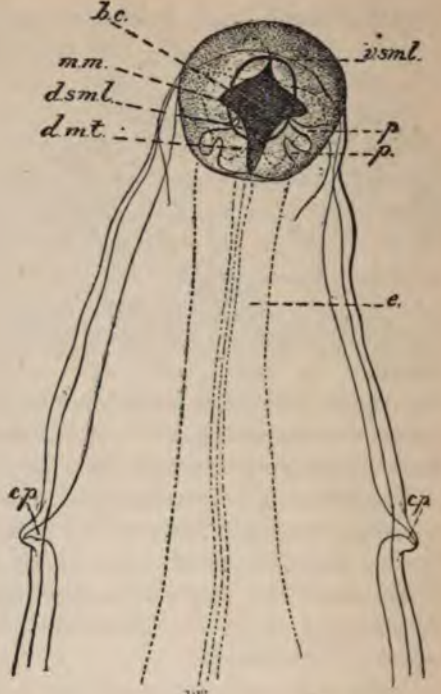
[a] This is *Uncinaria canina* (Ercolani, 1859) Railliet, 1900, a parasite of canines and felines, which is usually known as *Uncinaria trigonocephala* (Rudolphi, 1809) Railliet, 1885 [not *Uncinaria trigonocephala* (Rudolphi, 1809) Railliet, 1900]. If *Uncinaria* and *Agchylostoma* are recognized as distinct, *U. canina* should be placed in the same genus as *U. duodenalis*. I have not yet tested the correctness of the specific name *canina* for this form, but it is here accepted on authority of Railliet.

[b] This is *Uncinaria trigonocephala* (Rudolphi, 1809) Railliet, 1900 [not "*U. trigonocephala* (Rudolphi, 1809)" Railliet, 1885]. Both Railliet and I have recently examined Rudolphi's original material, and it is unquestionably identical with *U. cernua* (Creplin, 1829) of sheep. This species is closely related to *U. americana*.

[c] *Bunostomum phlebotomum* Railliet.





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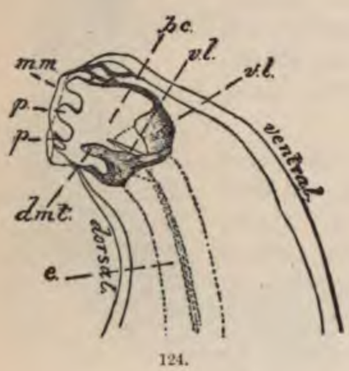

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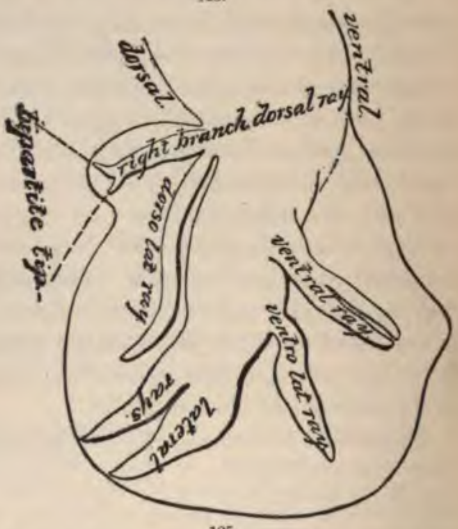

125.

FIG. 120.—New World male hookworm (*Uncinaria americana*). Natural size. Original.
FIG. 121.—New World female hookworm (*Uncinaria americana*). Natural size. Original.
FIG. 122.—The same, enlarged to show the position of the anus (*a*) and the vulva (*v*). Original.
FIG. 123.—Dorsal view of anterior end of New World hookworm (*Uncinaria americana*): *b. c.*, buccal cavity; *c. p.*, cervical papillæ; *d. m. t.*, dorsal median tooth, projecting prominently into the buccal cavity; *d. sm. l.*, small dorsal semilunar lip; *e.*, esophagus; *m. m.*, margin of mouth, the prominent oval opening seen upon high focus; *p. p.*, papillæ; *v. sm. l.*, large ventral semilunar lips homologous with the ventral hooks of *U. duodenalis*. Greatly enlarged. Original.
FIG. 124.—Lateral view of anterior end of New World hookworm (*Uncinaria americana*): *b. c.*, buccal cavity; *d. m. t.*, dorsal median tooth, projecting prominently into buccal cavity; *e.*, esophagus; *m. m.*, margin of mouth; *p. p.*, papillæ; *v. l.*, ventral lancets at the base of the buccal cavity, the left lancet is seen *en face*, the right lancet is seen from the side. Greatly enlarged. Original.
FIG. 125.—Lateral view of caudal bursa of the New World male hookworm (*Uncinaria americana*), showing the arrangement of the rays. Note the short dorsal lobe. Greatly enlarged. Original.

trouble just below the stomach. The writer has collected this parasite in Dewitt, Gonzales, Victoria, and Calhoun counties, Texas.

Uncinaria Lucasi was found several years ago in the seal pups of Alaska by Mr. Lucas, after whom the worm has been named. It is responsible for about 17 per cent of the deaths of the pups.

Still other species of hookworms are reported for other animals.

None of the species from animals mentioned above is known to affect man, nor has *Uncinaria duodenalis* of man been satisfactorily demonstrated to occur in other hosts than man.

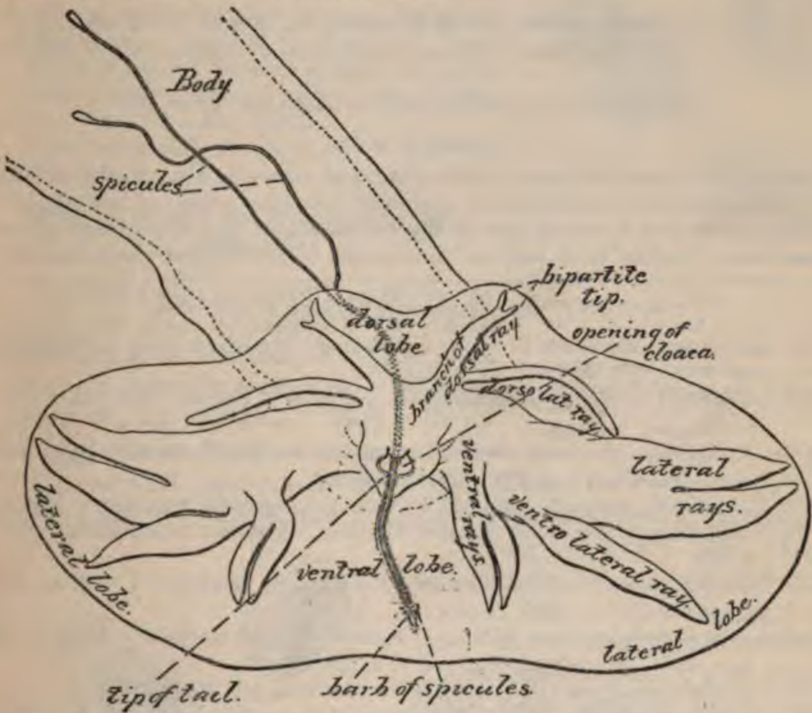

FIG. 126.—The caudal end of the New World male hookworm (*Uncinaria americana*). The bursa is spread out to show the arrangement of the rays. Note the short dorsal lobe which is subdivided, forming two lobes; note also the indistinct ventral lobe connecting the two lateral lobes. The dorsal lobe is thrown back over the body. Greatly enlarged. Original.

The genus *Uncinaria* was divided by Railliet (1897) into three subgenera, as follows:

Uncinaria (*Uncinaria*), confined to man and carnivores, and including *U. vulpis* and *U. duodenalis;*

Uncinaria (*Diploodon*), found in apes and edentates, and including *U. quadridentata* and *U. mucronata;*

Uncinaria (*Monodontus*), found in ruminants, hogs, and proboscidians, and including *U. cernua*, *U. semicircularis*, and *U. Sangeri.*

Later, Railliet (1902) divided *Uncinaria* into several genera, but I am not prepared at present to express an opinion upon their validity.

THE OLD WORLD HOOKWORM, UNCINARIA DUODENALIS[a] (DUBINI, 1843) RAILLIET, 1885.

(Figures 114 to 119, 128 to 141, 146 to 157.)

SPECIFIC DIAGNOSIS.—*Uncinaria:* Body cylindrical, somewhat attenuated anteriorly. Buccal cavity with two pairs of ventral teeth curved like hooks, and one pair of dorsal teeth directed forward; dorsal rib not projecting into the cavity. Male, 8 to 11 mm. long; caudal bursa with dorso-median lobe, and prominent lateral lobes united by a ventral lobe; for rays, see fig. 118; dorsal ray divides at a point two-thirds its length from its base, each branch being tridigitate; spicules long and slender. Female, 10 to 18 mm. long; vulva at or near posterior third of body. Eggs, ellipsoid, 52 by 32 μ, laid in segmentation. Development direct without intermediate host.

HABITAT.—In small intestine, chiefly in upper part, of man (*Homo sapiens*); also alleged to occur in certain apes. Africa, Europe, Asia, Philippines, introduced into America.

THE NEW WORLD HOOKWORM, UNCINARIA AMERICANA[b] STILES, 1902.

(Figures 120 to 127.)

SPECIFIC DIAGNOSIS.—*Uncinaria:* Body cylindrical, somewhat attenuated anteriorly. Buccal capsule with a dorsal pair of prominent semilunar plates or lips, similar to *U. stenocephala*, and a ventral pair of slightly developed lips of the same nature; dorsal conical median tooth projects prominently into the buccal cavity, similar to

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[a] SYNONYMY, WITH ORIGINAL PLACE OF PUBLICATION.

1843: *Agchylostoma duodenale* DUBINI <Ann. univer. di med., Milano, v. 106, aprile, pp. 5-13, pl. 1, figs. 1-5; pl. 2, figs. 1-3.

1845: *Ancylostoma duodenale* (Dubini) CREPLIN <Arch. f. Naturg., Berl., 11. J., v. 1, p. 325.

(1846): *Anchylostoma duodenale* (Dubini) DELLE CHIAJE <Rendicon. dell' Accad. delle sci., Napoli, v. 5, p. 339. [Not verified.]

1850: *Anchylostoma duodenale* (Dubini) DUBINI, Entozoografia umana, pp. 103-112.

1851: *Anchylostomum duodenale* (Dubini) DIESING, Systema helminthum, v. 2, p. 322.

?(1851): *Strongylus quadridentatus* SIEBOLD <Naturforsch. Versamml. z. Gotha. [Not verified.]

1861: *Dochmius anchylostomum* MOLIN, Il sottordine degli acrofalli <Mem. r. Ist. ven. di sc., lett. ed arti, Venezia, v. 9, pp. 485-487.

1864: *Sclerostoma duodenale* (Dubini) COBBOLD, Entozoa, pp. 361-362, fig. 77.

1866: *Strongylus duodenalis* (Dubini) SCHNEIDER, Monographie der Nematoden, Berl., pp. 139-140, 1 fig., pl. 9, fig. 3.

1866: "*Ancylostomum duodenate* Dubini" of WHITE <Boston M. & S. J., v. 75 (21), Dec. 20, p. 427. [Misprint for *Ancylostomum duodenale.*]

1876: *Dochmius duodenalis* (Dubini) LEUCKART, Die menschlichen Parasiten, v. 2 (3), pp. 410-460, figs. 235-239, 241-247, 249.

1885: *Uncinaria duodenalis* (Dubini) RAILLIET, Éléments de zool. méd. et agric., Par., pp. 357-359, figs. 245-248.

1894: *Anchilostoma duodenale* (Dubini) ABBAMONDI & CIPOLLONE <Gior. med. d. r. esercito [etc.], Roma, v. 42 (5), maggio, pp. 513-531. [Probably earlier.]

1897: *Anchylostamum duodenale* (Dubini) MÖHLAU <Buffalo M. J., v. 36 (8), Mar., pp. 573-579. [Misprint for *Anchylostomum duodenale.*]

Ankylostoma duodenale and *Ankylostomum duodenale* of various authors.

[b] ORIGINAL PLACE OF PUBLICATION.

1902: *Uncinaria americana* STILES <Am. Med., Phila., v. 3 (19), May 10, pp. 777-778.

Monodontus. Male, 7 to 9 mm. long; caudal bursa with short dorso-median lobe, which often appears as if it were divided into two lobes, and with prominent lateral lobes united ventrally by an indistinct ventral lobe; for rays, see figures 125-126; common base of dorsal and dorso-lateral rays very short; dorsal ray divided to its base, its two branches being prominently divergent and their tips being bipartite; spicules long and slender. Female, 9 to 11 mm. long; vulva in anterior half of body but near equator. Eggs, ellipsoid, 64 to 72 μ long by 36 to 40 μ broad, in some cases partially segmented in utero, in other cases containing a fully developed embryo when oviposited.

HABITAT.—Small intestine of man (*Homo sapiens*) in America (reported to date, from Virginia, Texas, Porto Rico, and Cuba).

TYPE SPECIMENS.—No. 3310, B. A. I., U. S. Dept. Agric.

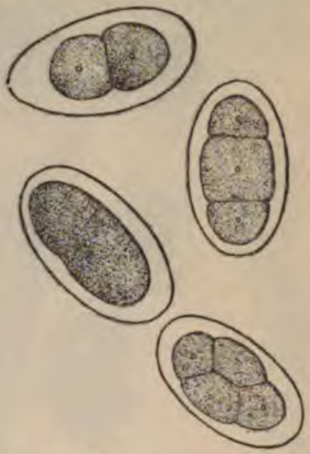

FIG. 127.—Four eggs of the New World hookworm, *Uncinaria americana*, in the 1, 2, and 4 cell stages. The egg showing 3 cells is a lateral view of a 4-cell stage. These eggs are found in the feces of patients and give a positive diagnosis of infection. Greatly enlarged. Original.

LIFE HISTORY OF UNCINARIA DUODENALIS.[a]

The eggs (fig. 128) are laid in the intestinal tract of the patient by the female worms and are discharged in the feces, either unsegmented or during the early stages of segmentation. They will not develop into adult worms in the intestine, but must first pass out of the body. Thus, for every adult hookworm present in the bowels a separate germ must enter the body.

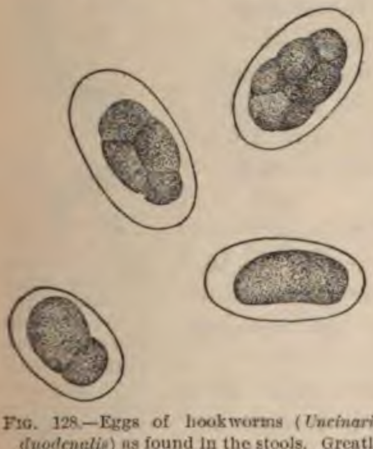

FIG. 128.—Eggs of hookworms (*Uncinaria duodenalis*) as found in the stools. Greatly enlarged. Original.

The egg has a thin shell, which is an indication of a simple life cycle. A short time after escaping in the feces—the time varying according to temperature, moisture, and position in the feces—each egg develops (figs. 129-141) a minute embryo, which is known as a rhabditiform embryo (figs. 139, 146). This name is given to it because of its resemblance to worms of the genus *Rhabditis*. Characteristic for this stage is the rhabditiform esophagus, which is entirely different from the esophagus of the adult *Uncinaria*. This embryonal esophagus is more or less bottle-shaped, and consists of three parts—an anterior elongated swollen

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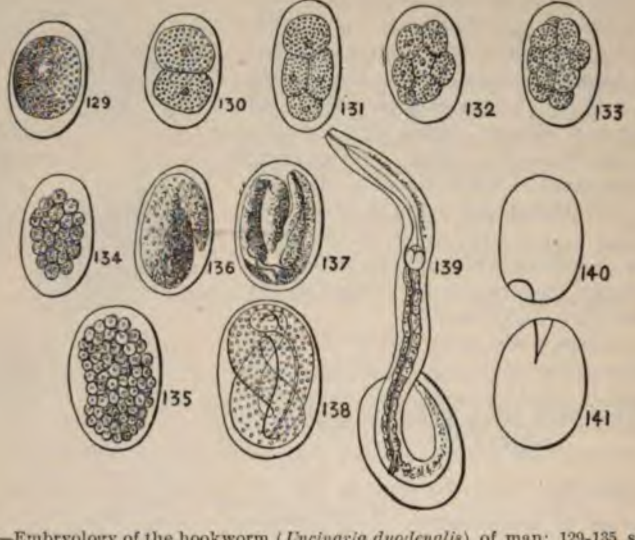
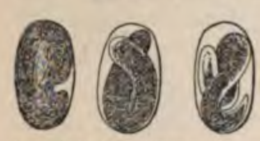
[a] The life history of *Uncinaria americana* has not yet been determined, but there is no ground for assuming that it will differ materially from that of *U. duodenalis*.



FIGS. 129-141.—Embryology of the hookworm (*Uncinaria duodenalis*) of man: 129-135, segmentation of the egg; 136-138, the embryo; 139, a rhabditiform embryo escaping from its eggshell; 140-141, empty eggshells. Greatly enlarged. (After Perroncito, 1882, p. 342, fig. 142.)

portion, followed by a thin middle portion, the latter being followed by a more or less globular esophageal bulb which possesses a triradiate chitinous armature. This kind of esophagus is common to the early stage of all members of the family Strongylidæ and also to numerous other free-living and parasitic nematodes. It is evidently a worm with an esophagus of this sort which was recently found in the earth taken from the New York tunnel excavations, and upon which was based the report that uncinaria sis was present.



FIGS. 142-144.—Three stages in the development of the embryo of a closely allied hookworm (*Uncinaria stenocephala*) of dogs. (After Leuckart, 1868, p. 435, fig. 250.)

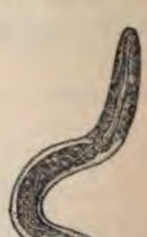


FIG. 145.—Free rhabditiform embryo of a hookworm (*Uncinaria stenocephala*) of dogs, showing the characteristic esophagus. (After Leuckart, 1868, p. 435, fig. 251.)

The embryo of the hookworm (*Uncinaria*) lives in water or moist ground. In its evolution the worm casts its skin four times, thus passing through five stages, and changes its structure so as to assume more and more the characters of the adult. During these changes the sexes become differentiated. Some of these changes occur in water or moist ground, and the rest after infection takes place.

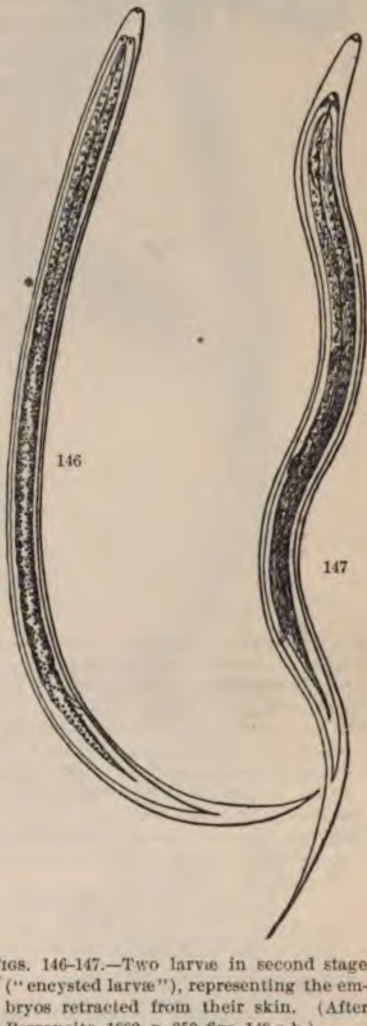
DEVELOPMENT OUTSIDE THE BODY.

Segmentation.—The eggs develop best in the unaltered fecal matter, especially when this is well formed; not so well when it is more fluid in character. The addition of water retards the development, and if considerable water is added the eggs perish. Air is necessary to development, and the eggs nearer the surface of the feces segment more rapidly than those in the center. At a temperature of about 27° C. the embryo may form and escape from the shell in twenty-four hours. Lower temperatures retard development, so that at 21° or 22° C. the embryo may not escape for from thirty-six to forty hours; 1° C. kills the eggs in twenty-four to forty-eight hours, so that freezing weather may be looked upon as disinfecting areas exposed to the cold.

Embryo.—Upon escaping from the shell, the embryo (fig. 139) measures 0.3 mm. in length; the anterior end is blunt, the tail long and pointed; 6 points are visible around the mouth, and these develop later into the papillæ; the buccal cavity is 10 μ long, 1.4 μ in diameter, and possesses a highly refractive chitinous membrane; the anus is 50 μ from the tip of the tail; excretory pore 50 μ from anterior end; 160 μ from anterior end is seen the primordium of the genital system.

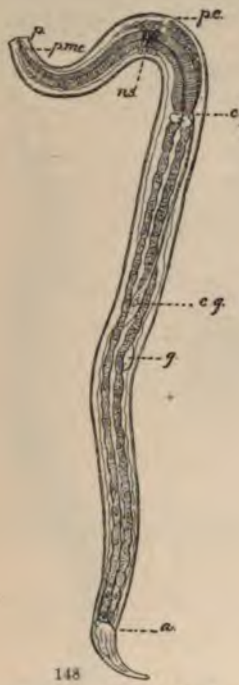
In this stage the embryo takes food and grows. After about four or five days (at 27° C.) it measures 480 μ long by 30 μ in diameter.

Second stage.—About the second or third day the embryo casts its first skin, but does not change its organization. After the fifth day the young worms begin to show signs of a second ecdysis, at the same time undergoing certain other changes. Three minute lips, each with two very delicate papillæ, appear under the skin at the anterior end; the brightly refringent cuticular lining of the buccal cavity and the chitinous teeth of the esophageal bulb disappear; the esophagus elongates, becomes thinner, and its three divisions become less distinct; the tail becomes slightly shorter and more blunt; the anus lies 90 μ from the tip of the tail. The organism becomes more motile, and contracts from its outer skin, thus forming the stage (figs. 146–147) which has been described as an "encystation," but which in



FIGS. 146–147.—Two larvæ in second stage ("encysted larvæ"), representing the embryos retracted from their skin. (After Perroncito, 1882, p. 350, figs. 148 a-b.)

reality is simply a second ecdysis. This is the infecting stage of the hookworm, and ends the development so far as the free stage is concerned. No more food is taken. In some cases, however, the worm escapes from the surrounding cast skin. While water is more or less injurious to the egg and the first stage, the infecting "encysted" stage exists well in this medium, and Looss (1897) succeeded in keeping these worms alive for thirty days in water. Upon drying up the larvæ die, so that the view that the worms exist in dust and are carried around in the air, thus leading to infection, is not well founded (see p. 199).



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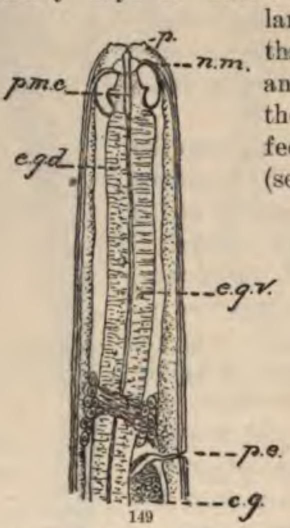

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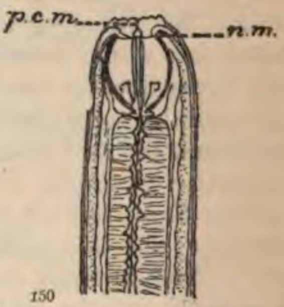

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FIG. 148.—A young hookworm (*Uncinaria duodenalis*) of man, without buccal capsule, four days after infection: *a*, anus; *c. g.*, cervical gland; *g.*, primordium of genital organs; *n. s.*, nervous system; *p.*, papillæ on head; *p. e.*, excretory pore; *p. m. c.*, primary mouth cavity. × about 190 times. (After Looss, 1897, p. 919, fig. 1.)

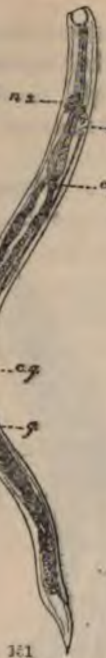
FIG. 149.—Anterior end of a young hookworm (*Uncinaria duodenalis*) during formation of provisional buccal capsule: *c. g.*, cervical gland; *e. g. d.*, dorsal esophageal gland; *c. g. v.*, ventral esophageal gland; *n. m.*, new mouth; *p.*, papillæ on head; *p. e.*, excretory pore; *p. m. c.*, primary mouth cavity. × 578. (After Looss, 1897, p. 920, fig. 2.)

FIG. 150.—Head of larval hookworm (*Uncinaria duodenalis*) before entering fourth stage, five or six days after infection: *n. m.*, new mouth; *p. m. c.*, primary mouth cavity, which extends through the provisional buccal capsule and continues as lumen of the esophagus. × 578. (After Looss, 1897, p. 921, fig. 3.)

DEVELOPMENT INSIDE THE BODY.

Upon being swallowed these young worms undergo further ecdyses, changing their internal organization at the same time. We may recognize, with Looss, a third stage, without buccal capsule (fig. 148); a fourth stage, with a provisional buccal capsule (fig. 151); finally, a fifth stage, with the definite buccal capsule, corresponding to the adult form.

Third stage (*without buccal capsule*, fig. 148).—During their free life the larvæ may attain 0.65 to 0.7 mm. in length by 25 to 27 μ in diameter (at the end of the esophagus). The esophagus is 160 μ long, and its three divisions may still be distinguished. The intestine is composed of about fifteen rows of two cells each.



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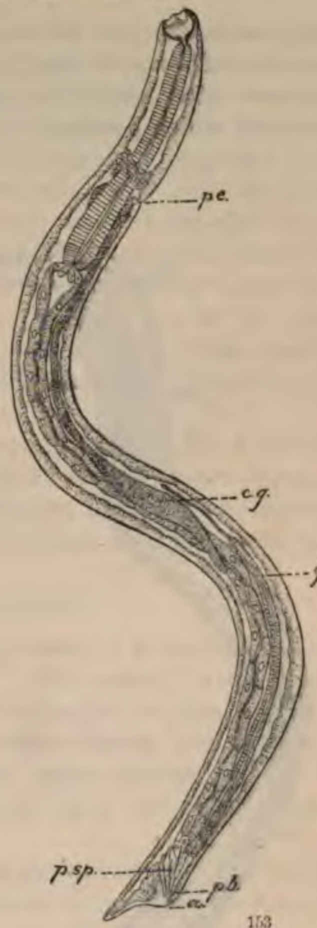

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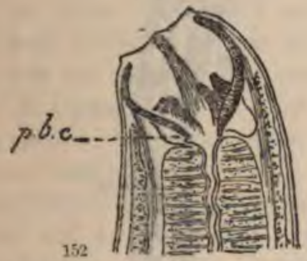

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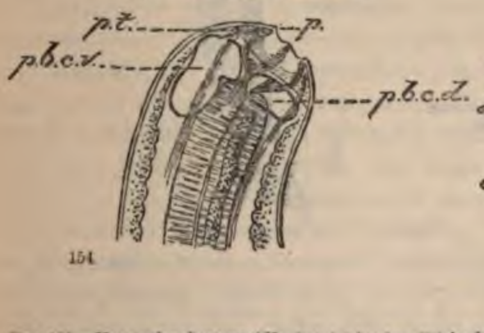

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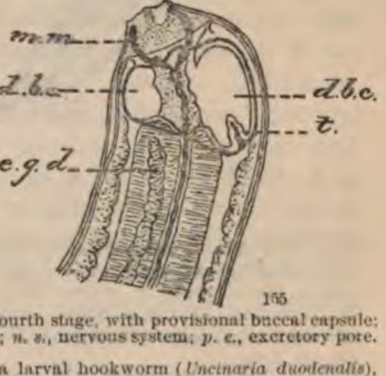

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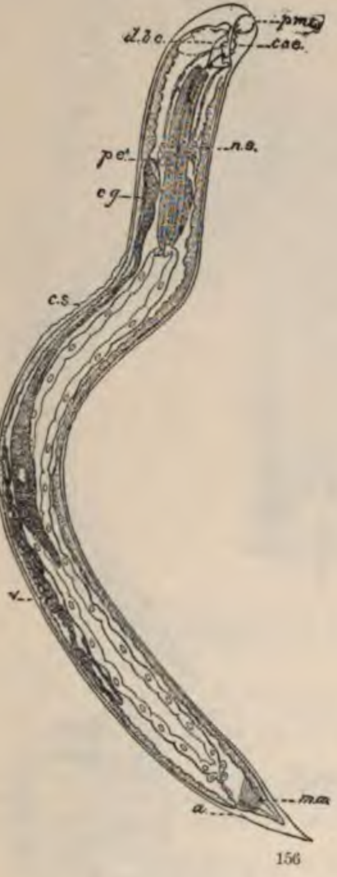
FIG. 151.—Young hookworm (*Uncinaria duodenalis*) in fourth stage, with provisional buccal capsule; *c. g.*, cervical gland, *g.*, primordium of genital organs; *n. s.*, nervous system; *p. e.*, excretory pore. X 105. (After Looss, 1897, p. 921, fig. 4.)

FIG. 152.—Provisional buccal capsule (fourth stage) of a larval hookworm (*Uncinaria duodenalis*), about nine days after infection: *p. b. c.*, primordium of definite buccal capsule. X about 420. (After Looss, 1897, p. 921, fig. 5.)

FIG. 153.—Young male hookworm (*Uncinaria duodenalis*), nine days after infection: *a.*, anus; *c. g.*, cervical gland; *g.*, genital tract; *p. b.*, primordium of bursa; *p. e.*, excretory canal; *p. sp.*, primordium of spicules. X about 105. (After Looss, 1897, p. 922, fig. 6.)

FIGS. 154-155.—Development of definite buccal capsule (154, on twelfth day after infection; 155, one or two days later): *d. b. c.*, definite buccal capsule; *e. g. d.*, dorsal esophageal gland; *m. m.*, margin of definite mouth; *p.*, papillæ on head; *p. b. c. d.*, *p. b. c. v.*, dorsal and ventral primordia of the definite buccal capsule; *p. t.*, primordium of ventral tooth; *t.*, ventral tooth; the new cuticle can be distinguished under the old. X 190. (After Looss, 1897, p. 923, figs. 7-8.)

Fifteen hours after infection of dogs the worms have passed below the stomach. They now begin to feed, but their growth is comparatively slow. After about five days they begin to show signs of a third ecdysis, which continues until about the seventh day. During this period important changes take place, especially at the anterior end, and result in the formation of the provisional buccal capsule.



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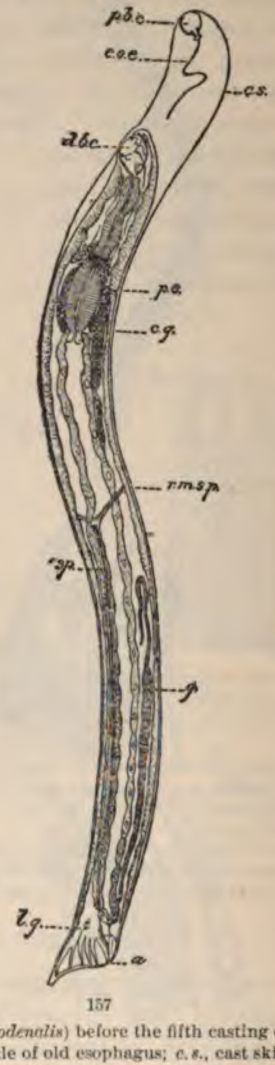

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FIGS. 156, 157.—Male and female hookworms (*Uncinaria duodenalis*) before the fifth casting of skin, 14 to 15 days old: *a.*, anus; *c.g.*, cervical gland; *c.o.e.*, cuticle of old esophagus; *c.s.*, cast skin; *d.b.c.*, definite buccal capsule; *g.*, genital organs; *l. g.*, large ganglion, supplying the rays of the bursa; *m.a.*, anal muscle; *n.c.gl.*, nucleus of cervical gland; *p.e.*, excretory pore; *p.b.c.*, provisional buccal capsule; *r.m.sp.*, retractor muscles of spicules, *sp.*, spicules; *v.*, vulva. X 42. (After Looss, 1897, p. 924, figs. 9-10.)

Fourth stage (*with provisional buccal capsule*, fig. 151).—This is the fourth larval stage, namely, the stage after the third ecdysis. The worms have not increased notably in length, but certain organs are advanced in development, and the esophagus no longer shows its former three divisions. The worms measure about 0.66 mm. long by 25 μ in diameter, the latter being nearly uniform for a greater part of the length (fig. 151). The provisional buccal capsule attains 40 μ in diameter, and the mouth is bent slightly dorsad. Two pairs of teeth are visible at the base of the capsule—one pair situated dorsally, the other ventrally. During this stage the animal increases in length and thickness, the inner organs become better developed, the sexes become differentiated, and the definite buccal capsule forms at the anterior end. With these changes the parasite prepares for its last—namely, a fourth—ecdysis, which occurs in about fourteen to fifteen days after infection.

Fifth stage (*with definite buccal capsule*).—The worm is now about 1.9 (male) to 2 mm. (female) long, 12 to 14 μ in diameter—very much smaller than the adult forms. It is estimated that the parasites require about four to five or six weeks from the time of infection to become mature.

SOURCE OF INFECTION.

The worms are swallowed in drinking water or in contaminated food during or after the second ecdysis. "Dirt eaters" are, of course, particularly liable to become infected, while persons handling dirt are apt to get the microscopic worms on their hands, and it is an easy matter to transfer them to the mouth, either directly or with food. In prevention, therefore, pure drinking water and careful personal habits are indicated.

Some writers state that the young stages are scattered in the air by the wind and in a dry state, the inference being that they may then be breathed in or may contaminate food. While not caring to go to the extreme of stating that such a method of dissemination or infection is impossible, my own observations on this class of parasites do not lead me to attach much importance to aerial infection. As a rule, drying out results in a high mortality among nematode larvæ, embryos, and eggs, while moisture, on the other hand, is necessary for their existence. Now, uncinariasis is not so common as to fill the air with dried larvæ, and the chances of inhaling the latter appear to be almost infinitesimally small. Since the worms do not increase in number in the intestinal tract, we should therefore expect (in case aerial infection were common) to find rather few cases of severe infection, but a more or less uniform light infection of nearly all persons or animals inhabiting an infected area, since all are breathing the same air. We should also expect to find the disease more general in dry years than in wet seasons. Such, however, does not appear to be the case. Cases of infection vary greatly in intensity, and the losses from nematode diseases in sheep are much less in dry years and in dry localities than in wet seasons. As a matter of fact, few factors can be conceived of which would probably result in killing more germs of this disease than would dry winds.

In preventing uncinariasis and nematode diseases in general among live stock, systematic draining and burning of pastures are strongly advocated.

Looss (1898, 1901) has recently suggested that the larvæ may enter the human body by way of the skin and then pass through the body to the intestine. Although he relates some interesting experiments which are decidedly favorable to his view, it will be well to exercise some reserve at present and not to accept this new theory unconditionally until it is more completely supported by further experiments. The present indications are, however, that Looss's theory is correct.

SYMPTOMS OF UNCINARIASIS IN MAN.

As stated above (p. 184), patients offer the characters of a pernicious anemia, with the circulatory symptoms found in all extreme anemias, namely, dizziness, palpitation, hemic murmurs; colicky pains in the abdomen; progressive enfeeblement, in some cases with considerable emaciation; constipation or diarrhea, stools sometimes brownish or bloody; nausea; edema. (See also "Abstracts of cases," pp. 206–217.)

Lutz (translated by Macdonald) summarizes the symptoms as follows:

I.—STAGE OF PURELY LOCAL SYMPTOMS.

(*a*) *Acute form;* (*b*) *chronic form.*—The symptoms are similar in both forms. The disease is yet limited to pains and disordered digestion; no pallor, no rise of pulse.

II.—STAGE OF SIMPLE ANEMIA OR OLIGOCYTHEMIA (CHLOROTIC STAGE).

(*a*) *Acute form.*—1. Slight degree: Conjunctival vessels still visible; nails and lips pale red; pulse increased in frequency; no blowing murmurs over cardiac area.

2. Higher degree: Conjunctivæ devoid of vessels; nails whitish; lips pale; pulse frequency very much increased. No blowing murmurs.

(*b*) *Chronic form.*—Anemia has not reached the highest degree. In many cases distinct cardiac hypertrophy and dilatation; in other cases disordered valve closure; seldom both combined. Moderate increase of frequency of pulse.

III.—DROPSICAL STAGE.

(*a*) *Acute form.*—A high degree of anemia; pulse small, much increased in frequency; no blowing murmurs; edema of a hydremic character.

(*b*) *Chronic form.*—Symptoms of cardiac defects, with disturbed compensation, or of fatty degeneration; distinct symptoms of cyanosis;

dropsy of engorgement; anemia of varying intensity; disordered nutrition.

In line with Looss's theory, Bentley (1902, pp. 190–193) has recently advanced the view that "grounditch," or "pani-ghao," a cutaneous disease, is due to the entrance, subcutaneously, of hookworm larvæ. He defines this disease as follows:

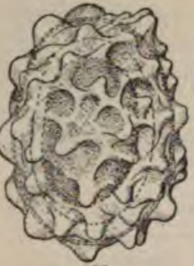
> "Grounditch—Synonyms: Pani-ghao, wateritch, waterpox, water sores, sore feet of coolies—is an affection of the skin, confined entirely to the lower extremities, and probably always associated with the presence of the larvæ of the *Ankylostoma duodenale* [=*Uncinaria duodenalis*] in the soil of the affected areas; endemic in Assam and the West Indies, and possibly present in other parts of the Tropics; characterized by its periodical epidemic appearance in the infected areas, coincident with the onset of the rainy season; with typical lesion consisting in a primary erythema, followed by a vesicular eruption, which frequently becomes pustular, and in severe cases may result in obstinate ulceration or even in gangrene."

CLINICAL DIAGNOSIS OF UNCINARIASIS.

Uncinariasis may be correctly and positively diagnosed in one way, and in one way only, namely, by an examination of the feces. Its recognition by this method is, however, exceedingly easy. First of all, let us recall that uncinariasis is a possibility which should be considered in connection with all cases of anemia, especially among earthworkers, as in miners, brickmakers, canal diggers, farmers, etc., or in persons returning from the Tropics. Two methods of fecal examination are open to us—the microscopic and the gross examinations.

MICROSCOPIC EXAMINATION OF FECES.

No special technique is necessary. Simply take a small amount of feces, preferably from near the surface, about the size of the head of a large pin; spread this out in a drop of water on an ordinary microscopic slide and cover the preparation with a cover slip. Examine under any moderately high power, as a Zeiss 8 mm., Zeiss C, or a Bausch & Lomb one-third-inch. Look carefully, with not too strong illumination, for an elongate oval egg with thin shell, and with protoplasm either unsegmented or in the early stages of segmentation. The older the feces and the warmer the weather the more advanced will be the segmentation. In case of infection with *Uncinaria americana*, the fully developed embryo may be found within the eggshell. Be cautious not to mistake for the egg of the *Uncinaria* the eggs of *Ascaris lumbricoides*, which have a thick gelatinous, often mammillated, covering and an unsegmented protoplasm (figs. 158–159), or the eggs (figs. 172–180) of the *Oxyuris vermicularis*, with a thin asymmetrical shell (one side being almost straight) and containing an embryo, or the eggs of whipworms (*Trichuris trichiura*, more commonly known to physicians as *Trichocephalus dispar*), possessing a smooth, thick shell, apparently perforated at each pole, and an unsegmented protoplasm (fig. 185).



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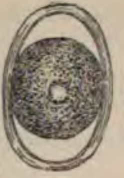

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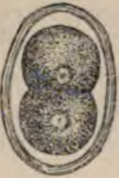

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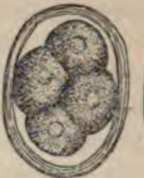

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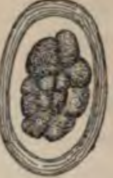

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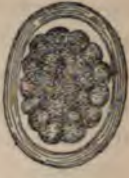

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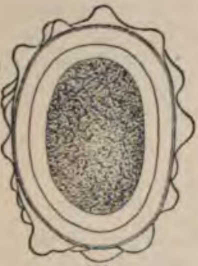

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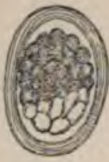

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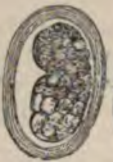

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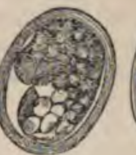

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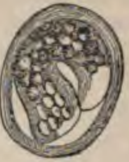

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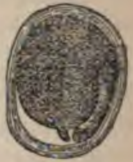

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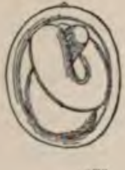

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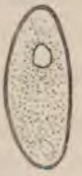

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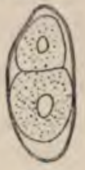

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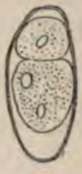

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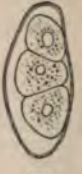

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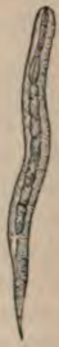

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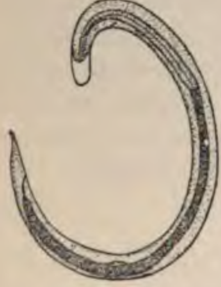

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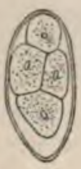

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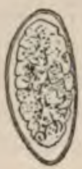

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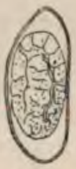

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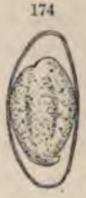

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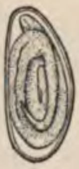

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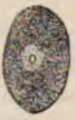

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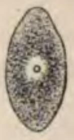

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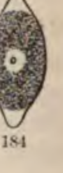

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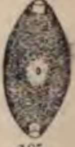

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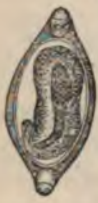

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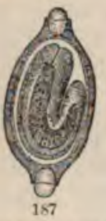

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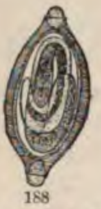

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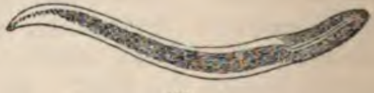

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FIG. 158.—Egg of the common ascaris (*Ascaris lumbricoides*) of man, as found in feces. Seen with superficial focus. Greatly enlarged. Original.

FIG. 159.—The same, as seen with median focus. Greatly enlarged. Original.

FIGS. 160–169.—Embryology of the common ascaris (*Ascaris lumbricoides*) of man, showing the changes undergone by the egg after being discharged in the feces. (After Leuckart, 1867, p. 213, fig. 154.)

FIG. 170.—Embryo of the common ascaris (*Ascaris lumbricoides*) of man, in the eggshell. (After Leuckart, 1867, p. 215, fig. 156.)

FIG. 171.—Free embryo of the common ascaris (*Ascaris lumbricoides*) of man, casting its skin. (After Leuckart, 1867, p. 214, fig. 155.)

FIGS. 172–179.—Embryology of the common pinworm (*Oxyuris vermicularis*) of man, showing the changes undergone by the egg while in the female worm. (After Leuckart, 1868, p. 322, fig. 191.)

FIG. 180.—Embryo of the common pinworm (*Oxyuris vermicularis*) of man, in the eggshell, as found in fresh feces. (After Leuckart, 1868, p. 328, fig. 196.)

FIG. 181.—Full-grown embryo of the common pinworm (*Oxyuris vermicularis*) of man, after it has escaped from the eggshell. (After Leuckart, 1868, p. 328, fig. 195.)

FIGS. 182–185.—Egg of the common whipworm (*Trichuris trichiura*) of man, showing changes undergone while still in the female worm; fig. 185 is the stage found in fresh feces. (After Leuckart, 1868, p. 491, fig. 275.)

FIGS. 186–188.—Later stages of development of an allied whipworm (*Trichuris affinis*) of sheep and cattle, showing changes after the egg escapes in the feces. (After Leuckart, 1868, p. 494, fig. 276.)

FIG. 189.—Isolated embryo of Trichuris affinis. (After Leuckart, 1868, p. 495, fig. 277.)

As a rule, in fecal examination I prefer to use the thick, large, 2 by 3 inch slide, such as is used in examining for trichinæ, rather than the ordinary 1 by 3 thin "English slide." The larger slide is not only more steadily and more easily manipulated in case one is working without a mechanical stage, but it is much cleaner to handle.

In most cases of infection with intestinal worms the simple method just described will suffice for a positive diagnosis. Before giving a negative opinion, however, I invariably make five to ten preparations or follow a procedure which we may call "sedimenting the feces." Experience has shown me that in cases of negative diagnosis by the simple method positive diagnosis frequently results if the feces are washed and "sedimented."

Method of washing and sedimenting feces.—Take one or two ounces of feces, fresh or dry, mix with water, and place in a large bottle, retort, jar, or any other receptacle; add enough water to make from a pint to two quarts, according to the amount of feces; shake or stir thoroughly and allow to settle; pour off the floating matter and the water down to near the sediment; repeat the washing and settling several times, or as long as any matter will float. The last time this is done use a bottle or graduate with a smaller diameter, and when the material is thoroughly settled examine the fine sediment. It will be found that the eggs have settled more numerously in the fine sediment than in the coarse material.

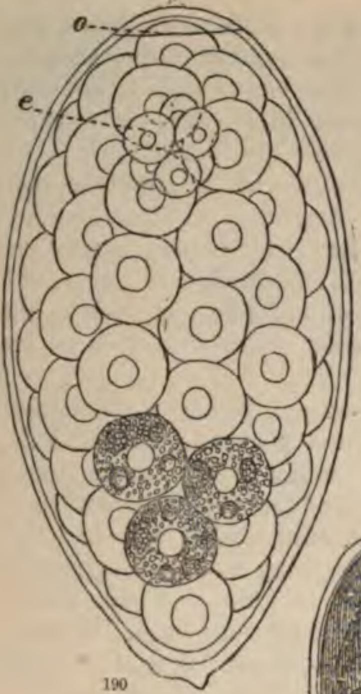
In case an unusual amount of large coarse material is present in the feces, it is sometimes convenient to pour the entire mass through a sieve, rejecting the portion left in the sieve; or to wash the feces in a sieve, holding the latter under water. As a rule, however, the sieve is not very useful in fecal examinations.

The centrifuge does not appear to be of any special value in fecal examinations.

If facilities are not at hand for making a microscopic examination, about an ounce of either perfectly fresh feces, or of rather dry feces, may be placed in a bottle, preferably with a large neck, properly packed in a mailing case, and sent to any professional pathologist or zoologist for examination.

GROSS EXAMINATION OF FECES.

If uncinariasis is suspected and it is not practicable either to make a microscopic examination or to delay matters until a specimen can be sent away for examination, still another method of diagnosis is possible. Give a small dose of thymol, followed by oil, and collect all of the stools passed. Wash the stools thoroughly several times in a bucket, and examine the sediment for worms about half an inch long, about as thick as a hairpin or hatpin, and with one end curved back to form a hook. If these are found, institute definite treatment.



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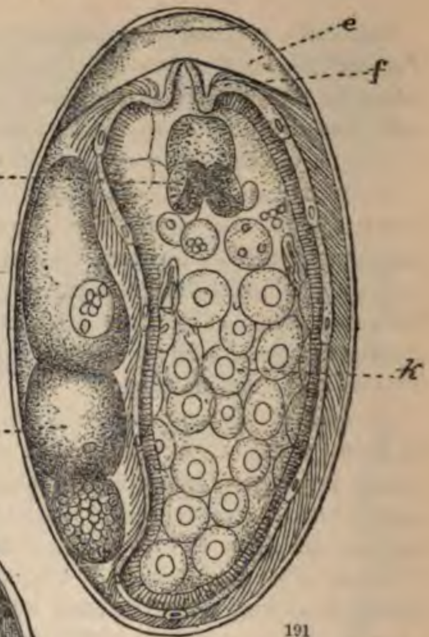

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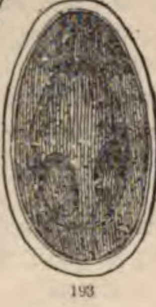

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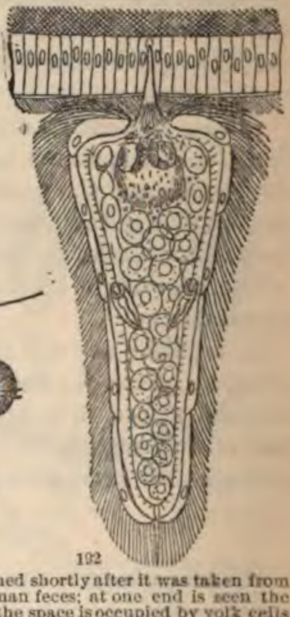

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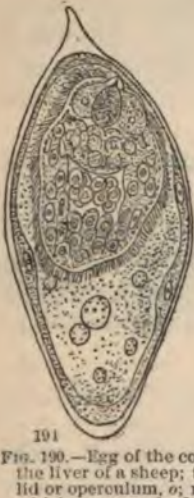

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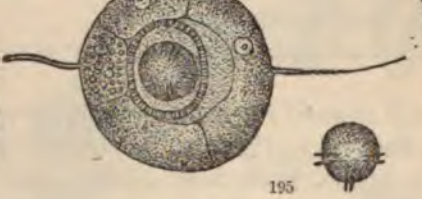

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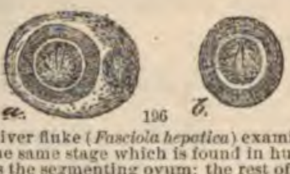

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FIG. 190.—Egg of the common liver fluke (*Fasciola hepatica*) examined shortly after it was taken from the liver of a sheep; this is the same stage which is found in human feces; at one end is seen the lid or operculum, *o*; near it is the segmenting ovum; the rest of the space is occupied by yolk cells which serve as food; all are granular, but only three are thus drawn. X 680. (After Thomas, 1883, p. 281, fig. 1.)

FIG. 191.—Egg of the common liver fluke containing a ciliated embryo (miracidium) ready to hatch out: *d*., remains of food; *e*., cushion of jelly-like substance; *f*., boring papilla; *h*., eye-spots; *k*., germinal cells. X 680. (After Thomas, 1883, p. 283, fig. 2.)

FIG. 192.—Embryo of the common liver fluke (*Fasciola hepatica*) boring into a snail. X 370. (After Thomas, 1883, p. 285, fig. 4.)

FIG. 193.—Egg of lancet fluke (*Dicrocœlium lanceatum*) with contained embryo. X 700. (After Leuckart, 1889, p. 379, fig. 171.)

FIG. 194.—Egg of human blood fluke (*Schistosoma hæmatobium*), with contained embryo, passed in the urine or in the feces. X 285. (After Looss, 1896, pl. 11, fig. 112.)

FIG. 195.—Egg of beef-measle tapeworm (*Tænia saginata*), with thick eggshell (embryophore), containing the six-hooked embryo (oncosphere), enlarged. (After Leuckart.)

FIG. 196.—Eggs of pork-measle tapeworm (*Tænia solium*): *a*., with primitive vitelline membrane; *b*., *without primitive vitelline* membrane, but with striated embryophore. X 450. (After Leuckart, *1880, p. 667, fig. 297.)*

As a rule, any physician can either make a microscopic examination himself or have one made for him, and under these circumstances treatment for worms on an uncertainty is hardly to be recommended. There are, however, exceptions to all rules.

TREATMENT OF UNCINARIASIS.

The two drugs most commonly used in cases of uncinariasis are thymol and male fern. The directions usually given for thymol treatment are these: Two grams (31 grains) of thymol at 8 a. m., 2 grams (31 grains) at 10 a. m.; castor oil or magnesia at 12 noon. Diet of milk and soup.

A week later the stools should be reexamined, and if eggs are still present treatment should be repeated. Some cases of hookworm disease are quite obstinate and require a treatment extending over several weeks. It is therefore an unfortunate error to expel a few worms with one or two doses and then dismiss the patient as cured, without having made further microscopic examination for eggs.

Stools during treatment should be disinfected. An easy disinfection is with quicklime.

In my experiments in Texas with uncinariasis of sheep, I have had excellent results with 32 to 60 grains of thymol given at one dose without a purge.

See also "Abstracts of cases," pages 206–217.

Several authors have wisely pointed out that alcohol should be withheld from a patient while he is taking thymol. Some authors, however, directly advise the use of alcohol during the thymol treatment. Theobald dissolves his thymol in alcohol before giving it to horses, and in experiments upon animals I have repeatedly used the alcohol method, the tablet, and the powdered thymol.

Theobald states that 3 grains have produced partial prostration in a bull terrier, and that the dose for roundworms in dogs should not exceed 2 grains, but he fails to give the weight of the dogs. In some recent experiments Mr. Pfender and I have given from 30 to 75 grains in alcohol to dogs weighing 8 to 35 pounds; one 15-pound dog went into convulsions a few minutes after receiving 30 grains in alcohol; one 15-pound dog also suffered convulsions after receiving 30 grains in alcohol. On the other hand, an 8-pound, old dog suffered no ill effects from 30 grains, while a 35-pound dog took 75 grains in alcohol without detrimental effects. The tablet form was found very unsatisfactory. Powdered thymol was given to dogs weighing 8 to 15 pounds in doses ranging from 10 to 100 grains. The dose of 100 grains killed a dog within four days. In one case a dog showed convulsions after receiving 20 grains of powdered thymol, and in two cases dogs vomited after taking 20 and 30 grains, respectively. On the other hand, several dogs took doses of 10, 20, 30, and 50 grains of powdered thymol without showing any effects. A dog weighing 35 pounds took 80 grains in powdered form. Blue foxes, to which we gave 3 grains in alcohol, were quite sick. On the whole, our experiments were unfavorable to the use of the alcohol solution.

PREVENTION OF UNCINARIASIS.

As preventive measures against this disease, I would propose the following:

(1) A medical examination, including microscopic examination of feces, of all men engaged in mining and similar pursuits, and exclusion from work of all persons affected with this malady until they have undergone treatment for expulsion of the parasites. This rather drastic measure, if followed, would in the end be economical both for miners and for mining companies. It would check the spread of the disease and would enable the men now affected to accomplish more work in a given time than it is possible for them to do if suffering from uncinariasis.

(2) That all new men engaged for mining and other similar work should submit to similar examination and treatment, if necessary, before being allowed to begin work. This will prevent the reintroduction of the disease into the mines.

(3) A compulsory regulation that men shall defecate before entering mines in the morning. This will lessen the necessity for defecation in the mines, hence it will lessen the chances of spreading infection.

(4) Construction of water-tight latrines in mines, tunnels, canals, and similar excavations. This will eliminate to a great degree the danger of adding to the infection already existing in the mines. Attempts to disinfect the mines against the eggs and embryos of *Uncinaria* are thoroughly impracticable.

(5) Compulsory use of said water-tight latrines in cases where it is impracticable to use the latrines above surface.

(6) That the contents of latrines in and around mines and excavations should be periodically destroyed, either by drying or burning with fire or quicklime, and should never be used for fertilizing purposes.

(7) Fresh, pure drinking water.

(8) Caution miners and similar earth workers of the necessity for personal cleanliness; thorough washing of hands and cleaning of nails before eating.

ABSTRACTS OF CASES OF UNCINARIASIS IN THE UNITED STATES.

The following is a list of the cases of uncinariasis which have occurred in man in the United States, so far as they are known to me, together with abstracts of the reports. The first general summary of uncinariasis for this country known to me is the following passage in Blanchard, 1888, pp. 769–770:

> In the United States, Chabert and Duncan encountered uncinariasis in Louisiana; Lyell diagnosed it in Alabama and Georgia. The observations of Heusinger and of Geddings for South Carolina and those of Little and Lethermann for Florida are doubtful, and refer rather to malaria. [Translation.]

Unfortunately, Blanchard has not given bibliographic references to the cases in question, but suspicion falls upon certain works quoted below:

Louisiana, prior to 1821 and 1850................? cases, ? deaths.

CHABERT (1821, pp. 188–193) directs attention to geophagism, adopted by lazy slaves in order to alter their health and thus escape work. He says that dirt-eating negroes are very numerous, and that the results of the custom are always serious, producing a kind of poisoning, and often resulting in death. The circumstances surrounding the cases described strongly indicate the possibility of uncinariasis as one of the factors involved, but attention may be directed to the fact that no mention is made of the presence of worms. This objection is, of course, not conclusive, for neither *Uncinaria duodenalis* nor *U. americana* was known in Chabert's day, and, furthermore, he also fails to refer to *Ascaris lumbricoides*, which would naturally be present in many, if not all, of the geophagic negroes, hence the failure to mention the presence of parasites can hardly be considered evidence.

DUNCAN (1850, pp. 194–195), in discussing diseases in the parish of St. Mary, La., makes the following significant remarks:

"A very common disease among negroes on plantations in this part of the country is a state of anæmia, very often attributed, and perhaps justly, to the pernicious habit of dirt eating. On examining negroes on plantations a medical man is surprised to meet with so many of these cases. Almost every large plantation has three or four and sometimes more of them. Until the vital powers of the system are beginning to be undermined, no marked symptoms of disease being visible to the eye of the planter, they are generally suspected of laziness or malingering. After this condition has existed for some time, the skin presents a paler hue than natural, or, if the subject is a mulatto, an ashy white, the lips, tongue, lining membrane of the mouth, and palms of the hands white, lacking the reddish tinge of health; the legs œdematous, abdomen distended, pulse full, soft, and frequent; action of the heart violent; if blood is drawn, it is pale and watery; respiration on the slightest exertion anxious and hurried; in fine, all the symptoms that characterize chlorosis in females. We find this condition of things in subjects of both sexes. Many of these cases are doubtless produced and aggravated by the deleterious habit of dirt eating. But I never heard a negro admit that he was addicted to the habit. Some admit that formerly, years ago, they ate dirt, but do not now; and others, trusty, truth-telling negroes on all other subjects, on this will lie most pertinaciously to the last, unless detected in the act. I am inclined to think that many of these cases are unjustly attributed to dirt eating. With many, no doubt, dirt eating is a symptom only of a diseased condition of the digestive organs and of the system generally. With them dirt eating is the same propensity which white females resort to to relieve a disordered, acid condition of the stomach by the eating of quantities of chalk, magnesia, etc. This condition of system is often, in my opinion, produced by a deficiency of suitable nutriment. The diet of negroes on most plantations being salt pork, corn bread, and molasses—rarely eating fresh meat and vegetables—a condition of the system is thus produced closely allied to scurvy. In addition to the symptoms above described, I have occasionally seen a spongy state of the gums. There is generally present functional and sometimes organic disease of the heart.

"The restoration of these cases to health, whether addicted to dirt eating or not, is troublesome and tedious. The moral has to be prescribed for as well as the physical symptoms. To restore the healthy condition of the body nutritious food, fresh meats, vegetables, and greens, porter or wine are necessary; and, as to medicinal agents, preparations of iron in any or all forms, combined with stimulating stomachics and bitter tonics, laxatives when indicated, and outdoor exercise. To cure the habit of dirt eating, many resort to the cruel methods of preventing the indulgence of it by tin masks for the face, iron gags, chaining on plank floors, etc. By using these means, it is true, the habit can not be indulged in, but the cause that produced the propensity still exists and the disease can not be cured so long as these depressing moral agents are used. Restore the healthy tone of the system, invigorate the subject, put rich blood into his veins, clothe him well, feed him well, and do not overtask him; arouse his feelings of pride, teach him to feel that he is a reasonable and rational being, and, in a majority of cases, success will attend our efforts and we shall have the satisfaction of rescuing a valuable servant from the grave."

Here also we must admit the possibility of unrecognized cases of uncinariasis.

Florida, prior to 1845 .... ? cases, ? deaths.

LITTLE (1845, p. 70) refers to cases which may possibly be uncinariasis, at least in part. He says:

"*Dirt eating.*—Apart from the sickening influence of malaria, we can not refrain from noticing the degeneration, mental and physical, of children reared in this extreme southern portion of the Union. During our first month's residence in Florida, in passing through the country, we often stopped boys on the road, not over 10 or 12 years of age, who presented the most abject state of degeneration imaginable; with head and body large, limbs shriveled and deformed, eyes dull and of a bilious tinge, lips colorless, and features distorted. This degeneration, by many, has been attributed to dirt eating, a propensity very general throughout the whole country."

BLANCHARD (1888, pp. 769–770) quotes Letherman, also, but the reference is not known to me.

Texas, 1864 .... 1 case, 1 death.

HERFF (1894, p. 615) mentions finding in the intestine of a Mexican lady, who died from anemia and chronic dysentery, certain worms "not much longer than three-fourths of an inch," which he thinks were hookworms.

Alabama and Georgia [date ?] .... ? cases, ? deaths.

LYELL'S observations referred to by BLANCHARD (1888, pp. 769–770) could not be found.

South Carolina [date ?] .... ? cases, ? deaths.

The observations by HEUSINGER and GEDDINGS, mentioned by BLANCHARD (1888, pp. 769–770) could not be traced.

St. Louis, Mo., October, 1893 .... 1 case, 0 death.

BLICKHAHN (1893, pp. 662–663): German, from Oberhausen, near Essen, carpenter; in America seventeen months; has been employed in brickworks in St. Louis, but Blickhahn believes infection took place in Germany. Diagnosis of uncinariasis by microscopic examination of stools. Short account of symptoms. Red corpuscles, 800,000. Treatment, male fern.

Galveston, Tex., 1894 .... 1 case, 0 death.

SCHAEFER (1901, p. 655): States that in the summer of 1893, Allen J. Smith found the eggs of *Uncinaria duodenalis* in human feces, but was unable to find the person from whom the stools had been discharged.

Buffalo, N. Y., 1896 .... 5 cases, ? deaths.

These cases were reported by MÖHLAU (1897, pp. 573–579) in an article which is not accessible to me at present. Allyn & Behrend (1901, pp. 63–66) have abstracted them as follows:

"Case I.—R., aged 48, brickyard worker. Eggs found in large numbers.

"Case II.—Albert H., aged 7. Stools contained *Ankylostoma duodenale, Trichomonas intestinalis, Cercomonas intestinalis.* Infection was traced to 1 Polish and 2 Italian laborers who were infected with the disease, and who worked in the brickyard of the patient's grandfather.

"Case III.—S. O., farmer, 52 years old. Symptoms of typhoid fever; spots; temperature, 103°; pulse, 114 to 120; diarrhea. Attack lasted from September 14 to September 26, and ended suddenly. High rectal [*sic*] douches brought away great numbers of parasites and eggs.

"Case IV.—Frank R., aged 46, stonecutter. Eggs of *Tænia solium* and *Ankylostoma duodenale* found The patient had been working in a brickyard along with Italians, who often suffered with severe colic, of which he himself complained at times.

"Case V.—A. F., bricklayer, aged 58 years. Was employed at the building of the St. Gotthard tunnel."

Richmond, Va., January, 1898 .... 1 or 2 cases, 0 death.

GRAY (1901, pp. 269–270): Female, 25 years old; very anemic, pale, nervous, "no appetite, though she was extremely hungry;" tongue and lips bloodless; ankles, edematous; pain in back and right side of abdomen, accompanied by dreadful feeling of depression, nervousness, and great weakness; stools with great quantities of mucus; frequently had spells of syncope while at stool. Diagnosis, anemia; treatment, iron, arsenic, etc.; no improvement; hunger increases, with loathing of food and nausea at sight of it. Microscopic examination of mucus in stool showed hookworms and a great number of their eggs. Treatment:

Oleoresin aspidii Tinct. vanillæ } āā	min. xlv.
P. gum. acac.	ʒ ss.
Aq. dist.	℥ j.

Ms.—Take entire mixture, and follow it in two hours with ℥ j. magnesia sulph. in a glass of water.

A large number of the parasites were discharged, recovery prompt, and no more parasites or eggs found in stools. Sister of above patient, 27 years old, had same symptoms; no eggs or parasites found; same treatment; recovery. Both sisters were native-born Americans.

New Orleans, La., May 3, 1899 .... 1 case, 0 death.

TEBAULT (1899, pp. 145–148): Boy, 15 years old, German descent, born in New Orleans. Author quotes Manson's account of symptoms, and describes his own patient. Has complained of illness a year and a half; lost color; pain over epigastrium, poor appetite, gradually grew weaker; paroxysmal spells of diarrhea, at times stools slightly bloody; had been treated for pernicious anemia and malarial anemia without benefit. Upon entering hospital, lips were blanched, tongue swollen and pale; hands and feet edematous, as were the lungs; temperature 100° to 101° F.; loud hemic bruit over aortic valve; liver slightly enlarged; spleen normal; urine light colored, sp. gr., 1.008, no albumin; appetite capricious, gastric irritability, headache; had had frequent diarrhea followed by constipation; vertigo and "eye specks;" not emaciated. Blood count, May 8, red corpuscles, 2,500,000; white, 30,000; *Plasmodium malariæ* present. Feces with eggs of *Uncinaria.* Treatment: Thymol 10 grains, three times daily between meals for two days, then large dose of castor oil; after a rest of four days, 1 oz. extract of male fern, followed by oil; numerous worms passed. Patient placed on arsenauro and compound syr. hypophosphites. May 28, male fern repeated. Recovery.

Baltimore, Md., April-May, 1900 .... 2 cases, 0 death.

Hemmeter (1902), Diseases of the Intestine, v. 2, p. 593, MS.: Both males, one an American, the other of German descent; one a soldier, the other said to be a sutler; both had been in Porto Rico, where infection is said to have taken place. Cases had been diagnosed as ulcerated dysentery, but examination of stools showed eggs of *Uncinaria;* the hookworms were also found. "Treatment in one case consisted of extract of male fern alone, which had been preceded by several doses of castor oil. Later on the patient was kept on a milk diet and given a prescription consisting of 10 grains of bismuth subgallate, 5 grains of betanaphthol, and one-fourth grain denarcotized extract of opium. This case was cured entirely, for no ova or parasites were seen in the stools five weeks after the beginning of the treatment.

"The second case was treated in a similar manner, but thymol was given in doses of 30 grains t. i. d., because extract of male fern had been used seemingly without effect; but thymol did not cause the expulsion of any more hookworms than had been the case under the male fern. The patient was irregular in attendance, and was lost sight of before I became convinced that he was cured. There were no ova and parasites in the last stool that I examined, but this stool was still diarrheic." Outcome: One cured, one doubtful.

Doctor Hemmeter has kindly placed the above data at my disposal.

Glen Island, N. Y., summer, 1900 .... 4 cases, 0 death.

Dr. Bailey K. Ashford, of the United States Army, has kindly placed the following unpublished notes at my disposal:

"The first observations made were upon a colony of Porto Ricans exhibiting the industries of Porto Rico at Glen Island in the summer season of 1900. In passing through their camps I found several who bore strong evidences of the disease clinically. From Dr. G. A. Peck, the health officer of New Rochelle, who was treating them, I obtained permission to make a study of the stools and blood. Uncinariasis was revealed in four of the colony of about twenty, and probably would have been so demonstrated in three-fourths of them had time permitted. Of these four, two were interesting. One, a boy of about 12, left his native island only five months previously in perfect health, according to his parents. To their surprise, after reaching an apparently healthy spot in New York, where they least expected anemia, he began to grow pale, and when seen by his physician was almost in collapse, with tremendously edematous feet and legs, hands, abdomen, and face, a loud hemic murmur heard in the large vessels, with pulsating veins and hypostatic congestion of the lungs. A severe grade of secondary anemia due to *Uncinaria duodenalis* was our diagnosis, and treatment with 40 grains of thymol brought away large numbers of the worms. The exact number was lost, but was about 360. The boy was afterwards placed on Blaud's pills, and in about six weeks was ruddy and well, with no trace of the disease which we believed would be fatal. The case is of importance in that no *Trichocephalus* were expelled, and no malarial organisms were found in the blood, nor did clinical symptoms of malaria manifest themselves—two contentions raised by Dobson, of India, as modifying the theory of the existence of an anemia due alone to *Uncinaria.*

"Another case of severe anemia was found in a man of about 45 years of age, from whom only 24 worms were expelled, but who had been the host of the worm for probably ten or fifteen years, from his clinical history. His anemia was severe; few *Uncinaria* were expelled. Under subsequent treatment with iron he improved. His case was, however, complicated with malarial fever of the æstivo-autumnal type."

Galveston, Tex., December, 1900–1901 .... 1 case, 0 death.

SCHAEFER (1901, pp. 655–658): White sailor in United States Marine-Hospital wards in St. Mary's Infirmary; age 40 years, born in Australia; since 11 years of age has been sailing, chiefly between United States and China, via Cape of Good Hope; August, 1900, on plantation in Mexico, remaining there sixty-five days, when failing health forced him to leave; there he had drunk unfit water; large numbers of persons on the same plantation suffered from same symptoms, and many died. September 10, began to notice bloody stools; admitted to hospital December 21, 1900; much emaciated and pale, with distinct icteroid tint of the skin and conjunctivæ; very weak, but able to stand and walk; ankles diffusely pigmented and pit on pressure, edema extending to knees; considerable discomfort from edema, dull pain in limbs, discomfort and tenderness in abdomen, especially in region of spleen; respiration variable, from slow to 30 per minute, generally rather shallow; pulse, 100, soft; soft systolic murmur in mitral areas; decided tenderness in left hypochondrium; temperature for the most part nearly normal or slightly subnormal, with irregularly appearing accessions corresponding to malarial-like paroxysms in which the temperature would often mount above 40° C.; distinct leucocytosis in which eosinophilia was apparent; *Amiba coli* in stools; also trichomonads and *Trichuris trichiura;* diagnosis by finding *Uncinaria* eggs in stools. Treatment: Ethereal extract of male fern, without result; then thymol, with passage of 90 to 100 hookworms; dose repeated, and more worms passed. Patient improved. Blood count February 17, red cells, 2,970,000; white, 14,300; February 18, hemoglobin, 57 per cent; polynuclear and polymorphonuclear elements, 90 per cent; large mononucleated, 2.5 per cent; small mononucleated, 1.6 per cent; eosinophiles, 6 per cent.

Philadelphia, Pa., 1900–1901 .... 3 cases, ? deaths.

ALLYN & BEHREND (1901, p. 63): Report that L. Napoleon Boston found the worms and ova in 2 cases and ova alone in a third case, which were referred to him for examination by another physician.

In a personal letter Doctor BOSTON gives me the following details: "Two cases in 1900, 1 case in 1901. All 3 patients were born in Porto Rico and had been in the United States but a short time; 2 females (1 colored), 1 male. The latter (a medical student) had had the disease in Porto Rico and was supposed to have been cured."

Galveston, Tex., 1901 .... 8 cases, 0 death.

SCHAEFER (1901, p. 655): States that Allen J. Smith found *Uncinaria* eggs in 2 medical students.

In a personal letter dated July 9, 1901, Doctor SMITH says that in an examination of 80-odd stools from medical students of the University of Texas he found eggs of *Uncinaria* present in 8 cases. He has kindly sent me material from one of these cases, and the parasites prove to be *Uncinaria americana.*

Washington, D. C., May–July, 1901 .... 1 case, 1 death.

CLAYTOR (1901, p. 1251): The most prominent symptoms are intense anemia, weakness, and dyspnea, with anorexia and gastrointestinal disturbances. Native American, Virginia farmer, 19 years old; since 16 physical and mental development tardy; appears about 14 years old. Expression dejected; skin very pale; faint yellow tint, not the lemon yellow of pernicious anemia nor yet the chalky white of advanced nephritis; face bloated, especially about eyes; mucous membranes extremely pale; body well nourished, but muscles extremely flabby. Heart's impulse widely diffused; the apex beat was in the fifth interspace and almost as far to the left as the midaxillary line; over the base there was a loud systolic murmur, the point of maximum intensity being in the pulmonary area; this murmur was also heard in the vessels of the neck; the second pulmonary sound accentuated; at the apex was heard a systolic murmur, which was transmitted to the axilla and to the angle of the left scapula; a faint diastolic murmur over a small area near apex. Feet and ankles edematous. Urine pale, clear, acid, sp. gr., 1.010. Red blood corpuscles, 1,577,000; whites, 4,400; four days later, hemoglobin, 30 per cent; macrocytes and microcytes, a few; polychromatophilia not observed; poikilocytes, a few; micro-, normo-, and megalo-blasts, none; leucocytes, small; mononuclear, 15 per cent; large transitional, 9 per cent; polynuclear, 71 per cent; eosinophiles, 5 per cent; myelocytes, none. Improvement under thymol treatment.

CLAYTOR (1902, pp. 28–38): Patient improved in condition, but afterwards died (August 4) of cerebral hemorrhage. Claytor reviews the case, gives general discussion of the disease, and account of postmortem observations in his own case.

STILES (1901, pp. 524–525): The following letter from Dr. R. H. Stuart is a strong confirmatory indication of my view that uncinariasis is not a recently imported disease among us, but that it has existed unrecognized for some years:

> STRATFORD, VA., *June 19, 1901.*
>
> DEAR DOCTOR: In answer to yours of 13th instant concerning the case of G——— R———, will say that it would be impossible for me to furnish you specimens of stools of similar cases at this time, as I have neither seen nor heard of any recently. I have seen many similar cases within the last eighteen or twenty years, and am sure that the disease was more frequent formerly than at present. Doubtless there are a number of cases in this section at present, but the doctors generally have been so unsuccessful in their treatment of such patients that the people, who are invariably poor, think it useless and a waste of money to employ medical attendance. I am sure that the physicians had no idea that the disease was anchylostomiasis, but, on the contrary, regarded it as an unaccountable malady or due to improper food or to eating dirt, clay, or fuller's earth, which is found in certain localities and was eaten by the people of this country much more frequently formerly than at present.
>
> I saw this boy, G——— R———, only once, or possibly twice, about two years ago, and sent him medicine several times. I gave him alteratives, tonics, purgatives, and antimalarial remedies with only temporary relief, if any.
>
> A boy living near me at present had this disease for years, but entirely recovered while using a decoction of pipsissawa and Vallet's iron mass.
>
> A boy named J——— G——— came to our country almshouse from the same neighborhood as G——— R——— some eight or ten years ago, and remained there several years under my treatment with only temporary relief. I finally advised him to try sailing, to eat all the oysters, fresh fish, etc., possible, and to take tincture of iron, with the result that he has entirely recovered.
>
> I feel confident that you [the case belonged to Doctor Claytor, not to me.—C. W. S.] have thrown light upon a subject that has been in utter darkness heretofore, and should I come across a similar case in the future I will notify you at once and send a sample of the stools should you desire.
>
> Yours, very truly, R. H. STUART.

The parasites in this case belonged to the New World species, *Uncinaria americana*.

Philadelphia, Pa., May, 1901 .... 1 case, 0 death.

ALLYN & BEHREND (1901, pp. 63–66): Prominent symptoms of uncinariasis are: Colicky pains in the belly, irregular bowels, with occasional attacks of diarrhea, nausea, and, more rarely, vomiting; great weakness, and in some cases considerable emaciation, and the circulatory symptoms found in all extreme anemias—dizziness, palpitation, and hemic murmurs. Authors give a short historical review and refer to cases by Boston, Blickhahn (1893), Möhlau (1897), Dyer, Tebault, Claytor (1901). Present patient, Italian boy, 15 years old, admitted to Philadelphia Hospital May 28, 1901; complained of pain in the epigastrium and muscular weakness; brick maker from Messino, Italy; arrived in New York March 26. On admission the prominent symptoms were epigastric pain, headache, flashes of light before eyes, muscular weakness and pains, marked constipation. Body well nourished, skin light tan or greenish yellow hue, contrasting sharply with finger and toe nails; palms of hands and lips almost absolutely colorless; conjunctivæ and scleræ blanched, tongue very pale and covered with heavy white fur, teeth spotted with sordes, buccal mucous membrane almost colorless; pupils equal and dilated; legs slightly edematous; knee jerks absent; vessels of neck pulsate strongly; capillary pulse plainly visible at finger tips; chest round, pectorals small, abdomen well nourished, lungs normal. Percussion area of heart increased, right border extending to right border of sternum, left border to nipple line, upper border to third, and lower to fifth interspace; impulse increased in area and forcible, a loud systolic murmur audible all over the heart and in cervical vessels. Percussion area of liver diminished, probably due to intestinal tympany. Spleen normal in size. Much mental hebetude. Diagnosis by fecal examination, eggs numerous; also eggs of *Trichocephalus dispar* [=*Trichuris trichiura*]. June 4, worse, considerably weaker; vomited a greenish liquid; a few microscopic worms [*Strongyloides intestinalis ?*. See below] in stools of June 3; patient has begun to emaciate. June 5, two worms pass after santonin. June 6, 75 worms pass after thymol. June 7, scattered retinal hemorrhages discovered in each eye by Doctor Hansell; double optic neuritis of low grade; blood column interrupted in veins; nervous pulsations; numerous small hemorrhages in neighborhood of disc and fovea; pigment changes from old hemorrhages; changes pronounced in left eye; no muscular disturbance. Blood count, May 28: Red corpuscles, 1,220,000; white, 8,650; hemoglobin, 15 per cent; polynuclear neutrophiles, 71 per cent; small lymphocytes, 21 per cent; large lymphocytes, 9 per cent; eosinophiles, 0.3 per cent. June 4, red corpuscles, 871,875; white, 6,212; hemoglobin, 15 per cent. Urine on admission, sp. gr., 1.012, alkaline, few phosphates, no sugar or albumin. June 8, sp. gr., 1.022, urates and phosphates present. Temperature on admission, subnormal; rose gradually; ranged between 100° and 102° F. for ten or twelve days; became normal June 13. June 15, red corpuscles, 1,062,500; white, 2,620; hemoglobin, 15 to 20 per cent. June 21, 100 worms passed after thymol. Steady improvement; later report promised. Here follows a general discussion, particularly of pathology, based upon other authors; short bibliography.—BOGGESS (1901, pp. 2530–2531): Account of same case.

I suspect very strongly that this case represented a mixed infection of *Uncinaria duodenalis* and *Strongyloides intestinalis*, for Dr. Emily Ray Gregory, who experimented some with the feces, wrote me, under date of July 21, 1901, that the embryos unquestionably developed into two sexes, the female of which was ovigerous, a description which points to the free-living generation of *Strongyloides*.

St. Louis, Mo., 1901 .... 1 case, 0 death.

DYER (1901, pp. 94–96): Patient, female, 45 years. Symptoms: Weakness, especially after exertion; feeling of heaviness, amounting at times to pain in region of stomach; eructation of gases; palpitation of heart; constipation alternating with diarrhea; later on patient became very anemic; anemic murmurs over base of heart; copious sweats, especially at night; evening temperature, 100° to 100.5° F.; great nervousness, insomnia; stools dark, more or less distinctly hemorrhagic; first diagnosis, dyspepsia; patient grew worse; microscopic examination of stools revealed *Uncinaria* eggs; thymol treatment; recovery.

Baltimore, Md., September–October, 1901 .... 1 case, 1 death.

HALL (1901, pp. 1464–1465): Englishman, 38 years old. Sailor between England and United States. Had recently visited Vera Cruz, Mexico. Bay View Hospital, October 2, 1901. Stools at times tinged with blood; patient very emaciated and anemic; 98° to 100° F.; eyes bright, pupils somewhat dilated, reacting normally to stimuli; conjunctivæ pale; tongue coated white, breath offensive. Clavicles and ribs prominent; skin free from eruptions and very pale. On auscultation, a few sonorous, sibilant, and mucous râles distributed pretty generally over chest. Respirations, 24. Dyspnea quite marked at times. Heart sounds weak, pulse 100. No increased dullness on percussion. Hemic murmur occasionally heard over apical region. No increased hepatic or splenic dullness. Pain-points evident over various portions of abdomen, on palpation. No lumps found in abdomen. Reflexes normal. No edema. Urine pale, sp. gr. 1.016; albumin and sugar absent. Sputum frothy. Red corpuscles, 2,500,000 per c. mm.; white, 24,000; great increase of polynuclear leucocytes and eosinophiles, the latter being 26 per cent; small percentage of nucleated microblasts and normoblasts; poikilocytosis absent; a few microcytes and macrocytes, the former predominating; a few days later slightly increased leucocytosis. Pains in abdomen were of a dull, nagging character, with occasional paroxysm of great severity. About two days prior to death, red corpuscles, 800,000 per c. mm.; white, 29,600; hemoglobin, 11 per cent; nucleated reds increased; slight poikilocytosis, with some increase of microcytes; increase of polynuclear and decrease of eosinophiles, the latter aggregating only 3 per cent; lymphocytes and mononuclear leucocytes, few. Respirations became labored and fewer. Feces contained eggs, the character of which was not recognized. Death, October 19. Autopsy by Doctor Yates: Body marble-white, rigor mortis slight, eighteen hours after death. Peritoneal cavity contained excess of clear fluid, but surfaces smooth and glistening. Pleural cavities contained some turbid-looking fluid; no apparent congestion; some old adhesions to posterior chest wall. Lungs edematous on dependent portion; much black pigmentation of tissue, and old tubercular foci were present (antemortem examination of sputum showed no tubercular bacilli). Bronchi contained much frothy fluid, but no evident congestion of mucous membrane. Pericardial cavity with small amount of clear fluid. Blood clot in heart, pale and tenacious; section of cardiac muscles showed evidences of fatty degeneration; valves apparently normal. Liver and kidneys showed evidences of fatty degeneration. All viscera extremely pale. About 5 or 6 inches from beginning of duodenum, a small amount of hemorrhagic substance, containing hookworms; same condition continued downward, until about 6 feet from jejunum a more striking condition was encountered: worms present in great numbers, alive and attached. Entire intestinal canal bathed in a tenacious mucus; mucous membrane pale, here and there slight hemorrhagic areas; greater hyperemia along free margin of valvulæ conniventes. Postmortem diagnosis: Ankylostomiasis [=uncinariasis].—J. AM. M. ASS. (1901, pp. 1466–1467): Editorial reference to Hall's case; references to cases of Ashford (1900, pp. 552–556, April 14), Allyn and Behrend (1901, pp. 63–66), Claytor (1901), and short general discussion.—YATES (1901, pp. 366–372): Author gives a more detailed account of the postmortem examination. A point of particular interest is the fact that "the basal part of the [intestinal] mucosa was infiltrated with eosinophiles in enormous numbers, so closely packed together that 75 were counted in one field of the oil immersion. They were essentially of the type described in the spleen and appeared to have replaced the lymphoid elements which are normally present in such large numbers. There was an induration of the tissue with fibroblastic cells. In the submucosa eosinophiles were present in almost equally great numbers, occurring packed together in groups and rows between the fibrous tissue strands. Eosinophilic cells were found in small numbers within the interstitial tissue of the circular muscular coat, but less frequently in the longitudinal coat. A few were present beneath the serosa. They were also seen to have penetrated the glandular structures and were found between the epithelial cells and in the lumina of the glands. No eosinophilic cells were found with signs of nuclear division. The nuclei of certain of these eosinophiles were seen to stain deeply and homogeneously, the eosinophilic granules becoming somewhat pale and less distinct. The nuclei in this instance took on a much more polymorphous form, finally undergoing fragmentation into numerous small particles. In a few cells with fragmented nuclei the granules were still to be recognized, where as a rule only a faint pink homogeneous cell-body was visible. Since this fragmentation was most marked nearer to the mucosa and in the points of greatest infiltration and was present to a comparatively slight extent in the spleen, it was probably the result of a degeneration caused by the action of some toxic substance."

Through the kindness of Dr. Yates, I have been able to examine specimens from this case. All of the worms thus far examined belong to the Old World species, *Uncinaria duodenalis*.

New York, October–December, 1901 .... 1 case, 0 death.

Dr. Preston H. Bailhache, Surgeon in Command, United States Marine-Hospital Service, Stapleton, N. Y., has kindly placed the following notes on this case at my disposal: "Patient, male, 23 years old, native of Finland, merchant seaman; place of infection unçertain; was in Brazil in April, 1901, but since that time has been coasting in the United States, as far south as Florida. Diagnosis first made on symptoms, and confirmed by finding the eggs in microscopic examination of feces; treatment: thymol, and subsequently male fern; recovery."—Greene, 1902 (p. 460): Gives an account of this case; treatment, male fern; improvement, but patient left hospital before fully recovered.

Washington, D. C., June, 1902 .... 1 case, 0 death.

Through the kindness of Dr. A. B. Herrick, I have been able to examine parasites from an unpublished case of uncinariasis in a soldier who has recently returned from the Philippines. The worms in question belonged to the Old World species, *Uncinaria duodenalis*.

Florida .... ? cases, ? deaths.

That uncinariasis exists in Florida can hardly be questioned. (See below, Cuban cases.)

Mississippi .... ? cases, ? deaths.

One of the American physicians (Dr. Kirby-Smith) who saw several cases of uncinariasis in Cuba has recently stated to me that this disease is undoubtedly present in Mississippi, but that its exact nature has not been recognized. He is convinced that he himself has seen a number of cases which were confused with malaria.

New York (State) [date ?] .... 2 cases, ? deaths.

Through the kindness of Dr. George Blumer, Bender Hygienic Laboratory, Albany, N. Y., I have learned that two or three cases of uncinariasis have been observed in New York State—one by Doctor Ward, another by Doctor Neumann. The second case was in an Italian. I am not yet in possession of the full details connected with these observations.

EXTRA-STATE CASES.

Porto Rico, 1900 .... 19 cases, 0 death.

Ashford (1900, pp. 552–556): First to diagnose uncinariasis in Porto Rico. He says it is the most destructive and general disease on the island.

"*The subjective symptoms.*—It is difficult to obtain a history of the disease from its inception, for many have it from infancy. Generally it is possible to obtain some such history as this: A variable appetite, some nausea and vomiting, pain in epigastrium, either constipation or diarrhea (or these may alternate), sometimes dysentery; swellings of the feet and ankles, no loss of weight, sleeplessness, restlessness, tinnitus aurium, giddiness, faintness, severe headache, palpitation of the heart, progressive debility; little perspiration, but kidneys active; fever sometimes, but not chills. I have not been able to get a history of geophagism nor of intestinal hemorrhage described by some authors. Sometimes the patients improve for a time after medication, but not permanently.

"*Objective symptoms.*—Pallor: This is divided into three classes by a prominent physician, but I can not see that it has reference to more than the individual color of the patient, whatever that may be, irrespective of the disease. The conjunctivæ, lips, tongue, gums, nails, and cheeks are in some cases perfectly pallid, the mucous membranes especially being of a deathly white. The skin is generally a pasty yellow, a dirty brownish gray, or a grayish white. Expression: A passive expression is often seen, and its peculiar character is heightened by puffiness of the eyes and bloating of the face. Edema: This is simply the usual accompaniment of severe anemia. Practically every variety is seen, the chief being, in order of importance, edema of the feet and ankles, edema of the face, ascites, and edema of the scrotum. Hypostatic congestion of the lungs exists often. The important point is that with this disease there may be emaciation. This has not been present often in my cases; on the contrary the patients are apparently well nourished. Anemic ulcers are sometimes seen on the legs and an incorrect accusation of syphilis may be made. Corneal ulcers are at times seen. One of my cases presented corneal ulcers of both eyes. Respiratory symptoms: Generally none from this disease save in increased rapidity of breathing from anemia, serous accumulations, or hypostatic congestions. Liver: No constant symptom. Spleen: No constant symptom. Heart: These symptoms are very aggravated; signs of a pernicious secondary anemia. Pulsating vessels: Both jugulars, superficial veins of the arm, and vessels about the root of the neck and heart in severe cases with greatly dilated heart; pulsating suprasternal and supraclavicular regions and diffused pulsations in the anterior thoracic wall. All kinds of deductions might be made by a careless observer. Hemic murmurs are almost constantly present, and are in many cases heard in the veins of the neck. The urine: No albumin is found and the specific gravity is constantly low. The pulse is weak, rapid, soft, and compressible. The blood: Attention is invited to the accompanying summary of blood examinations. The following deductions are drawn: 1. A severe anemia, falling as low as that of Addison's anemia in count of red cells in some cases. 2. A very low hemoglobin average and a very low color index. 3. A marked eosinophilia in some cases. Forty per cent reached in one case. This follows the observation of Neusser. 4. No leucocytosis common to the disease itself. Leucocytosis recorded is always apparently due to complications, as noted. 5. Frequent presence of normoblasts, and in some cases megaloblasts, but never a majority of megaloblasts. 6. Poikilocytosis common. Manson denies this. 7. Utter unreliability of blood foods without removal of the cause, the ankylostoma. This blood examination was the first line of research taken up, and, as soon as anemia was proved, the patient was given blood tonics with temporary supporting treatment suited to the individual case, with the idea that the patient might be carried along until the true cause could be discovered. Of course, now, all treatment has been substituted by anthelmintics, chiefly male fern and thymol, and the blood and heart tonics will be again tried when the eggs have disappeared from the feces. I was led to examine the stools carefully from the high eosinophile count, and it is certainly evident that trichinosis has a rival for high counts in ankylostomiasis." Ashford gives an interesting table of blood examinations.

Cuba, 1901 .... ? cases, ? deaths.

The United States Army Medical Museum possesses specimens of feces, containing *Uncinaria* eggs, from man, brought from Cuba by Dr. James Carroll.—A personal letter from Dr. John Guiteras, of Habana, Cuba, informs me that he has found a number of cases of uncinariasis. In one family from Florida several members showed infection, and other cases were found in native Cubans. The cases will soon be reported. Doctor Guiteras very kindly forwarded to me several of the parasites collected. Most of the specimens proved to be *Uncinaria americana*, but several specimens were *U. duodenalis*. Thus we see that Cuba presents the double infection.

A further point of interest is that *Uncinaria americana* may be expected to spread to Spain, as it in all probability must have been present in some of the Spanish troops who returned from Cuba.

Hawaii, 1901 .... ? cases, ? deaths.

Pratt (1901, p. 1259): According to the J. Am. M. Ass., 1901, p. 1259, Executive Officer Pratt has issued to each government physician a letter indicating the prevalence of severe cases of uncinariasis.

Philippine Islands .... ? cases, ? deaths.

Several army surgeons who have recently returned from the Philippines have informed me that uncinariasis is found at Manila.—Dr. Joseph J. Curry has very kindly sent to me for examination specimens of hookworms taken from an American soldier in Manila, P. I. They belong to the Old World species, *U. duodenalis*.

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FROGS, TOADS, AND CARP (CYPRINUS CARPIO) AS ERADICATORS OF FLUKE DISEASE.

By CH. WARDELL STILES, PH. D.,
Zoologist of Bureau of Animal Industry.

[Figures 197 to 203.]

There have been a number of suggestions made in regard to methods of prevention of liver-fluke disease (distomatosis), and some of them, especially the free use of salt, appear to be valuable. Mr. William Ashmead, of the United States National Museum, upon returning from the Hawaiian Islands, told of a method which had been tried there with good results, namely, the introduction of frogs and toads into infected districts to devour the snails, which act as intermediate hosts. This method is entirely new to me, and appears to be a good one.

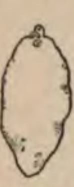
FIG. 197.—The common liver fluke (*Fasciola hepatica*), natural size (original).

Dr. Ernest N. Hutchinson, an inspector of this Bureau, stationed at Portland, Oreg., has recently called my attention to a decrease in liver-fluke disease following the introduction of carp into an infected district. These interesting notes by Dr. Hutchinson are worthy of serious attention, and, as Dr. Evermann, ichthyologist of the United States Fish Commission, has recently expressed it, they "justify us in scoring one more for that much maligned but exceedingly useful fish." Dr. Hutchinson writes:

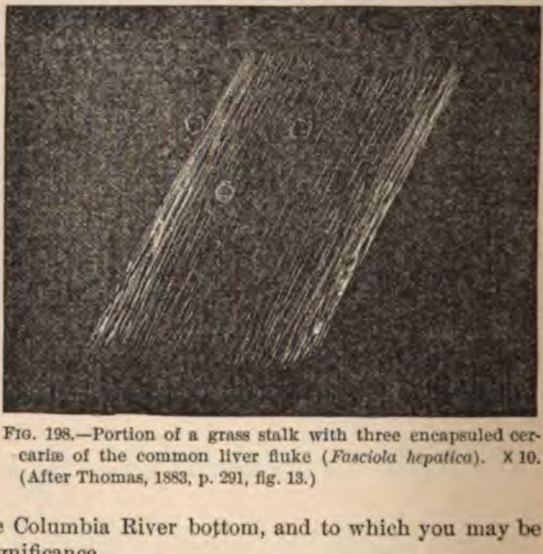
FIG. 198.—Portion of a grass stalk with three encapsuled cercariæ of the common liver fluke (*Fasciola hepatica*). × 10. (After Thomas, 1883, p. 291, fig. 13.)

I desire to acquaint you with some peculiar points concerning *Fasciola hepatica* which prevail in the minds of stockraisers pasturing on the Columbia River bottom, and to which you may be able to attach some practical significance.

Prof. C. V. Piper, of the Washington Agricultural College, in conversation with me, mentioned the theory which I find is, as he said, extant in the minds of many farmers along this river, namely, that "leeches" [liver flukes], which were formerly numerous in the livers of cattle and sheep, have to a considerable extent disappeared since the introduction of carp into the waters of this river.

While, of course, the farmers' idea is that the carp now consume the leech which, according to their view, the cattle formerly swallowed with the water while drinking, it is possible that there may be a practical connection between certain peculiar habits of this fish and the noticeable freedom from fascioliasis among the cattle and sheep ranged on the bottoms adjoining streams in which these fish are found, compared with animals coming from other sections where carp are unknown. About 75 per cent of the cattle and sheep coming from the western slope of the Cascades, exclusive of this Columbia River bottom, are infested with *Fasciola hepatica;* but from this particular portion only about 5 per cent are so infested.

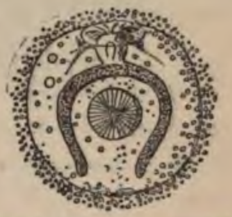

FIG. 199.—Isolated encysted cercaria of the common liver fluke. X 150. (After Leuckart, 1889, p. 286, fig. 142.)

All the bottom lands of this river are subject to annual overflow, and at this time the carp clean the meadows as thoroughly as a fire. Every spear of grass, up to the very water's edge, will be eaten by them. They also have a habit of rooting all around the edge of this overflow as it gradually recedes.

It has occurred to me, therefore, as possible that they destroy the final cystic stage of this parasite with the grass, and perhaps in their rooting they may also destroy some of the snails.—*Letter dated December 2, 1901.*

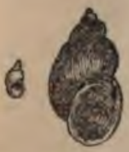

FIG. 200.—*Limnæa truncatula*, natural size and enlarged. (After Leuckart.)

Replying to your letter No. 4092, of the 16th ultimo, I have to inform you that inquiries addressed to certain small butchering establishments whose main source of supply would be lands adjoining carp-bearing streams, to ascertain the frequency with which they encounter the liver fluke, has failed to secure a single reply.

The carp were introduced into the waters of the Willamette River at Portland, Oreg., about eight years ago. They have multiplied very rapidly, and are quite numerous in the lakes and sloughs adjoining the lower Willamette and Columbia rivers. They have not, however, gone upward in these streams more than a few miles, seeming to prefer sluggish waters and stagnant sloughs.

Mr. A. E. Gebhart, secretary of the Oregon fish commission, in describing their feeding habits, likens them to the hog, saying they will eat anything that is eatable in the way of vegetation along the edges of sloughs and on the meadows at the time of overflow. They also root about in search of roots and such animal life as may be within their reach. He also says they will eat clams, as he has tried them as bait.

I am able to say that fascioliasis is much less common in animals from the lower Columbia and Willamette slough lands than from any other swampy districts of Oregon or Washington.—*Letter dated January 4, 1902.*

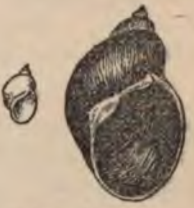

FIG. 201.—*Limnæa peregra*, natural size and enlarged. (After Leuckart.)

Referring to correspondence No. 4092, I have to report to you that while at Ridgefield, Wash., on the 17th instant, I was able to confirm somewhat the theory that the carp in the waters of streams reduce the dangers of fascioliasis in sheep. Mr. J. B. Campbell, for whom I inspected sheep for passage into Oregon, states positively that since the introduction of carp the flukes have entirely disappeared, and are no longer found in sheep pasturing on the bottoms, but that they are to be found as commonly as ever in sheep which feed upon the moist uplands.

As Mr. Campbell informed me that he had lost about 30 sheep from some mysterious disease, and that other sheep owners in his vicinity had also lost many, I

> endeavored to find a cause for this mortality. I made postmortem examinations of three sheep from as many different bands, each individual showing a marked degree of cachexia aquosa, with no acute inflammation of any organ. The musculature was pale, flabby, and watery. The retroperitoneal connective tissue was saturated with a semigelatinous, clear, transparent material. A considerable collection of this semifluid substance followed the attachment of the mesentery and the intestine. The blood was palish, and, while of a quite clear red when discharged from the vessels, it did not make a marked stain upon the white clothing with which it came in contact. Great numbers of the *Strongylus filaria* were present in the lungs, and much of the lung tissue was collapsed and in a state of carnification, particularly the ventral border and caudal third of the principal lobes. *Strongylus contortus* was also very numerous in the fourth stomach, the submucosa of which was the site of the same clear, semigelatinous infiltration noticed in the abdominal subserous tissues.
>
> These animals had pastured continually upon the low bottom lands, and were entirely free from *Fasciola hepatica.*—*Letter dated February 20, 1902.*

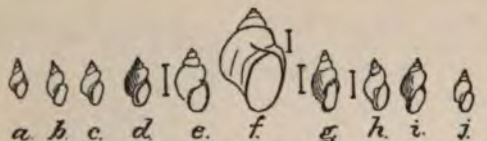

FIG. 202.—*Limnæa humilis*, natural size and enlarged. (After Binney.)

In corresponding with the United States Fish Commission on the subject, the following letter has been received from Dr. Evermann:

> Your letter regarding the carp is very interesting, and it justifies us in scoring one more for that much maligned but exceedingly useful fish.
>
> I do not know of any observations which have been made specifically for the purpose of determining whether the carp feeds upon *Limnæa* [swamp snails which serve as intermediate host of *Fasciola hepatica*], but there is no doubt in my own mind but that it does so. Carp will feed freely upon all sorts of small mollusks and crustaceans which it finds in the water, and when carp are able to go out in overflow ponds they will certainly clean up everything edible in the way of animal and plant material. I would be very glad to know more of this matter. Can you give me the localities to which you refer, and any more details?—*Letter dated December 11, 1901.*

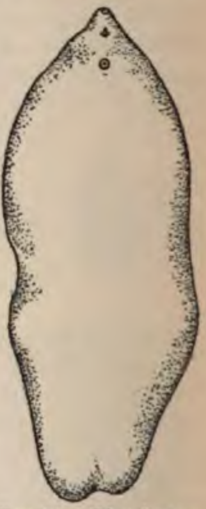

FIG. 203.—The large American fluke (*Fasciola magna*), natural size (original).

The action of the carp in this case appears to be very strongly supported by the facts stated, and it seems that the introduction of carp into fluke districts generally would result in a great decrease of liver-fluke disease.

FURTHER INVESTIGATIONS ON VERMINOUS DISEASES OF CATTLE, SHEEP, AND GOATS IN TEXAS.

By Ch. Wardell Stiles, Ph. D.,
Zoologist of Bureau of Animal Industry.

In the last Annual Report of this Bureau an account[a] was given of certain parasitic diseases found among cattle, sheep, and goats in Texas. After that article was written another trip was made (June, 1901) to the same localities in order to study the maladies further. A comparatively dry spring, together with the extensive burning of the pastures during the winter, had resulted in a great reduction in the disease among the cattle. In fact, few complaints were received or heard of. A flock of sheep and goats upon which experiments in treatment had been made the previous winter was examined and found to be still suffering with intestinal worms. The infection was in all probability recent—that is, since the last treatment—for the sheep had immediately improved after receiving their medicine, but had continued to feed on the same pasture, which had not been burned.

Several preliminary experiments with thymol alone, with 1 per cent coal-tar creosote alone, and with the two combined, were made to determine the relative efficiency of these drugs. It was found that a 1 per cent solution of creosote combined with from 32 to 75 per cent powdered thymol gave the best results; the creosote solution alone gave the next best results while thymol alone appeared to have but little, if any, effect upon the stomach wireworm (*Strongylus contortus*). The entire flock was then dosed with the creosote and thymol, and, according to last accounts, the animals have been doing well since that time.

Immediately upon returning from Texas the general results of these experiments upon treatment were issued in circular[b] form. In order to give these results more general distribution the circular is herewith reprinted, although it is in part a repetition of portions of the article which appeared in the last Annual Report:

TREATMENT FOR ROUNDWORMS IN SHEEP, GOATS, AND CATTLE.

Sheep, goats, and cattle suffer from the effects of roundworms. This is especially true during wet years. These parasites are found particularly in the lungs, the fourth stomach, and the bowels, and, when present in large numbers, they may result in the death of 5 to 50 per cent of a flock. For some of these parasites treatment is possible, but for others treatment has not been found altogether satisfactory.

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[a] Verminous diseases of cattle, sheep, and goats in Texas, Seventeenth Annual Report (1900) of the Bureau of Animal Industry, U. S. Dept. Agric., 1901, pp. 356–379.

[b] Circular No. 35, Bureau of Animal Industry, U. S. Dept. Agric., 8 pp.

TREATMENT.

Roundworms which live free in the fourth stomach or in the bowels may be expelled by using various drugs in drenches. A long list of medicines might be mentioned, but many of the drugs most highly recommended frequently fail to effect a cure. Failures are due to several causes: The drug itself may be of little or no value; it may not be administered in the proper dose; it may not be administered in the proper way.

One of the most commonly used drenches is turpentine, but more satisfactory results are obtained from the use of coal-tar creosote, or coal-tar creosote and thymol, or gasoline, or bluestone.

COAL-TAR CREOSOTE.

I have had excellent success in treating sheep, goats, and cattle for the twisted wireworm (*Strongylus contortus*) with a 1 per cent solution of coal-tar creosote. The medicine is easily prepared and quite inexpensive. It may be purchased of the druggist in small quantities of one ounce or in pound bottles. One ounce is sufficient for about 20 adult sheep, and the cost of the treatment is less than one-half a cent per head; if creosote is purchased by the pound, the cost is reduced to less than one-quarter of a cent per head. If creosote is called for at a drug store, beechwood creosote will usually be dispensed. This is more expensive than the coal-tar creosote and not so satisfactory in expelling worms.

A 1 per cent solution of coal-tar creosote is made as follows:

Coal-tar creosote	1 ounce.
Water	99 ounces.[a]

Twisted wireworms (*Strongylus contortus*), taken directly from the stomach of sheep or cattle die in one-half to one and a half minutes when immersed in this solution.

If, in dosing, this liquid enters the lungs the animal may succumb in a few minutes. If the dosing is performed carefully, as much as 6¾ ounces may be given to a full-grown sheep without fatal results. In some cases, however, the animal shows ill effects, from which it usually recovers within half an hour. Six ounces were given to a number of sheep without the slightest ill effects. The following table gives the doses of the 1 per cent mixture which were used in about 400 cases without ill effects:

Lambs 4 to 12 months old	2 to 4 ounces (about 60 to 120 c. c.).
Yearling sheep and above	3 to 5 ounces (about 90 to 150 c. c.).
Calves 3 to 8 months old	5 to 10 ounces (about 150 to 300 c. c.).
Yearling steers	1 pint (about 480 c. c.).
Two-year-olds and above	1 quart (about 960 c. c.).

Sheep, goats, and calves which received this treatment showed a marked improvement a few days after receiving a single dose.

In experiments with creosote at Washington, D. C., sheep were drenched with a 1 per cent solution and killed immediately afterwards. Upon opening the fourth stomach, it was found that the wireworms present were dead. In some cases where this was tried later, the wireworms were found to be still alive; but it is believed that the explanation of this fact has now been discovered (see below, page 228). Creosote does not appear to have much effect upon the worms below the stomach.

If an overdose is given by mistake, and if the sheep appears severely affected by it, the animal should be placed in the shade. Even in some cases of very severe overdoses, where the animal is given up for dead practically, it may entirely recover within an hour or so.

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[a] 99 ounces = 6 pints and 3 ounces.

COAL-TAR CREOSOTE AND THYMOL.

If, in addition to the stomach worms, the animals were suffering from severe infection of bowel worms, such as the hookworms, better results were obtained in the treatment when powdered thymol was added to the creosote. In cases of this kind, the creosote solution is prepared, as directed above (p. 224), and 30 to 80 or even 100 grains of thymol added to each dose after it has been measured.

Thymol is expensive, the price varying in different parts of the country. It may be purchased by the ounce, but it is considerably cheaper if purchased by the pound. Avoid using thymol which has become yellowish or reddish and which has run together in the bottle so as to form a solid mass. Powder the crystals and have the druggist measure 30 grains. Give 30 grains to a lamb, about 50 grains to a yearling, and 70 to 80 or 100 grains to older sheep, according to size.

In experiments I have had excellent results with a single dose of the creosote and thymol mixture. If necessary, however, the dose could be repeated after a week.

BLUESTONE.

In the recent experiments with bluestone by Hutcheon, in South Africa, against wireworm disease in sheep, it has been claimed that the same treatment expels tapeworms.

Caution.—Repeated accidents have happened from using too strong a solution or too large doses, or in giving it in such a way that the medicine gained access to the lungs. Dr. Hutcheon's method of procedure, which is here given in detail, is safe in the hands of the average farmer if the directions are followed. The person who gives stronger doses than indicated, or who is careless about the measurements, must take the entire responsibility of the miscarriage of the treatment. It is a good plan to make up a smaller quantity of the solution and try it upon a few sheep before attempting to dose the entire flock.

(*a*) *To prepare the mixture.*—Hutcheon has changed his formula slightly from time to time. On February 21, 1895, he gave the following proportions:

Dissolve 1 pound avoirdupois (1 pound = 16 ounces) of good commercial powdered bluestone (sulphate of copper) in 2 imperial quarts (= 2⅖ quarts U. S.) of boiling water; when the bluestone is thoroughly dissolved, add 6½ imperial gallons (= 26 imperial quarts = 7⅘ U. S. gallons = 31⅕ U. S. quarts) of cold water, making in all 7 imperial gallons (or 8⅖ U. S. gallons) of water.

In 1897 he changed the strength of the solution to 1 pound of bluestone to "40 whisky bottlefuls of water." This is practically 1 pound to 7½ imperial gallons (= 9 U. S. gallons = about 34 liters, metric) of water.

Use only bluestone which is of a uniform blue color; avoid that which is in conglomerate lumps with white patches and covered with a white crust.

The equivalents of 1 pound avoirdupois and of 7 imperial gallons in other weights and measures are as follows: One pound avoirdupois = 1 pound 2 ounces 280 grains of apothecaries' (also is equal to 453.59 grams of metric weight). Seven imperial gallons = 8 gallons 3 pints 3 fluid ounces 3 fluid drams 56 minims (or practically 8 gallons 3¼ pints, or 8⅖ gallons) of apothecaries' (also is equal to 31.804409 liters, metric system).

The farmer is cautioned against guessing at the weights and measures, for this is sure to result either in too strong a solution, which will kill his animals, or too weak a solution, which will fail to be effective. Scales and measures should be tested before they are used. If reliable scales are not at hand, buy the bluestone already weighed and have the exact weight in avoirdupois', apothecaries', or metric system marked on the package.

If a smaller quantity than the above is desired, this can be made up in the proportion of 1 ounce avoirdupois of bluestone to 4⅕ U. S. pints of water.

(*b*) *Preparation of the animals.*—Fast the sheep or cattle 20 to 24 hours before dosing. If the fast is 30 hours (longer fasts are dangerous), an extra half gallon or a gallon of water should be added to the solution, as animals are more liable to suffer after a long fast.

(*c*) *Size of the dose.*—Hutcheon has several times changed the size of the doses he advises, in some papers basing it on the imperial fluid ounce and in others on the tablespoon. The doses for sheep (in imperial ounces and in tablespoons) given below are his most recent (January 10, 1895) recommendations, and, though based upon a solution with 5 per cent less water than the first solution given above, they may be used for the weaker mixture.

I have given the metric doses to a number of sheep and goats, and the animals showed no ill effects. On the contrary, they gained in weight.

Size of dose for animals at several ages.

Age of animals.	Approximate equivalents.			
	Tablespoons.[a]	Imperial.	United States apothecaries.	Metric.
For a lamb 3 months old	1	About ¾ fluid oz	About ⅔ fluid oz	About 20 c. c.
For a lamb 6 months old	2	About 1½ fluid oz	About 1⅓ fluid oz	About 40 c. c.
For a sheep 12 months old	3	About 2¼ fluid oz	About 2 fluid oz	About 60 c. c.
For a sheep 18 months old	4	About 3 fluid oz	About 2⅔ fluid oz	About 80 c. c.
For a sheep 24 months old	4½	About 3⅜ fluid oz	About 3 fluid oz	About 90 c. c.
For a calf 3 months old	4½ to 5	About 3⅜ to 3¾ fluid oz.	About 3 to 3⅓ fluid oz	90 to 100 c. c.
For a calf 6 months old	5 to 5½	About 3¾ to 4⅛ fluid oz.	About 3⅓ to 3⅔ fluid oz	100 to 110 c. c.

[a] "The tablespoon I refer to is the modern, full-sized tablespoon (6 fluid drams). The medicinal tablespoon contains exactly half an ounce."—*Hutcheon.*

Be careful not to give a two-toothed young sheep as much as a full-grown, four-toothed sheep. Mistakes may occur in judging the age unless the teeth are examined.

The doses should be measured off in bottles and the point of each dose plainly marked with a file.

(*d*) *Dosing.*—In dosing use long-necked bottles—as castor-oil bottles, Worcestershire sauce bottles, or anchovy-sauce bottles—or, better still, a drenching tube.

Let one person set the sheep on its haunches and take its fore legs in his left hand while he steadies the head with the right. Another person inserts the neck of the bottle into the mouth. The head of the sheep should not be raised too high, as in that case the solution may enter the lungs and kill the sheep. A safe rule is to raise the nose to the height of the animal's eyes.

(*e*) *Overdose.*—If, after dosing, any of the sheep seem to be suffering from an overdose—indicated by lying apart from the flock, not feeding, manifesting a painful, excited look and a spasmodic movement in running, walking with a stiff gait, purging, the discharge being a dirty brownish color—take them away from the flock to a shady place and dose with laudanum and milk as follows: For a lamb 4 to 6 months old, 1 teaspoonful of laudanum in a tumbler of milk; for a sheep 1 year old, 2 teaspoonfuls of laudanum in a tumbler of milk. Repeat half the dose in two to three hours, if necessary.

(*f*) *After-treatment.*—The animals should not be allowed water for several hours after receiving their dose.

I have used bluestone on several occasions, and, although it proved more or less successful. it was not so satisfactory as creosote or as gasoline.

GASOLINE.

Gasoline has recently gained considerable reputation as a vermifuge. I have used it in a number of cases and have found the claims made for it to be more or less justified. Three objections, however, arise to its use, and I can not, therefore, consider it an ideal treatment. These objections are:

(1) Not less than three doses, and usually four to six, are required to expel the worms. Its use involves a great expenditure of labor, and it is therefore impracticable on the large ranches.

(2) While several doses are not necessarily injurious to the stock, still, if the doses are large, repeated drenches cause a more or less severe congestion of the bowels. Not only that, but repeated handling of range sheep, with the necessary preliminary treatment of withholding food, is injurious to the animals.

(3) If used on animals suffering from pleurisy, it is likely to be fatal. I have had several fatal cases of this kind.

Nearly all vermifuges are, however, more or less poisonous in one way or another, and gasoline, if properly used, is not particularly dangerous. The necessity of repeating the dose from four to nine times in order to effect a complete cure will, however, militate against its general adoption.

If gasoline is used, ammonia also should always be kept on hand. If an animal is suddenly overcome by the effects of gasoline, a small amount (a teaspoonful or so) of aromatic spirits of ammonia may be given in water as a drench, to be repeated if necessary, and will usually result in the recovery of the patient.

The usual doses of gasoline for stomach worms are:

Lambs	¼ ounce.
Sheep	½ ounce.
Calves	½ ounce.
Yearling steers	1 ounce.

I have used these doses repeatedly without any serious effects. Each dose is mixed separately in linseed oil, sweet milk, flaxseed tea, or an egg, and given as a drench. If given directly in water it is more severe on the patient.

An ounce and a half of gasoline has resulted in the immediate death of a full-grown ewe, but in some cases I have given to full-grown sheep as much as 2 to 3 ounces without serious results. I have also given as much as 3 ounces to a yearling steer and 7 ounces (within an hour) to a horse without causing serious symptoms. I have also given 3 ounces to a full-grown chicken; the animal became very stupid for a time, but eventually recovered. On the other hand, in one case, a yearling steer, in apparently quite healthy condition, succumbed within two minutes after a dose of 1½ ounces. These large doses were given experimentally to determine the danger point, and they should never be used by farmers in treating stock.

In one instance a steer was suddenly overcome because the man who was administering the dose for me accidentally held the head too high and the medicine entered the lungs. The animal fell immediately and appeared to be almost dead. I happened to have a hypodermic syringe with me and some tablets of sulphate of strychnine. A hypodermic injection of this substance was immediately given and within five minutes the animal was feeding as if nothing had happened. This incident led me to overdose several animals with gasoline and then to try to revive them with hypodermic injections of strychnine. In all cases the treatment was successful. It is thus seen that injury from gasoline may be counteracted by either aromatic spirits of ammonia or by strychnine.

METHODS OF DRENCHING ANIMALS.

The popular method of drenching is with a bottle. The use of a drenching tube is, however, far more satisfactory. A drenching tube may be made by taking an ordinary tin funnel, which may be purchased for 5 or 10 cents, and inserting the narrow end into one end of a rubber tube or hose, say 3 feet long and three-eighths or one-half inch in diameter; into the other end of the rubber tube is inserted a piece of three-eighths-inch brass or iron tubing about 4 to 6 inches long.

The metal tube is placed between the animal's back teeth, and the sheep or calf is allowed to bite upon it. The water or drench is poured into the funnel, which may be held by an assistant or fastened to a post at a convenient height. The man who holds the metal tube between the animal's teeth can control the animal's head with the left hand, and by holding the tube in the right hand, near the point of union of the rubber and metal tubes, he can easily control the flow of the fluid by pinching the rubber hose. Care must be taken not to hold the patient's nostrils closed, otherwise the dose will enter the lungs.

It is usually advisable to fast animals twelve to sixteen hours before dosing.

POSITION OF THE ANIMAL DURING DRENCHING.

Different persons prefer to hold the animals in different positions during drenching. Thus (1) the animal may be left standing on all four feet; or (2) it may be placed on its haunches, one man holding its back up against his own body; or (3) it may be placed directly on its back on a sloping piece of ground, its head being in a direct line with its back, and higher than its rump; or (4) it may be placed upon its side, the head being brought around so that the horns are squarely on the ground; the operator may then place one foot on one of the horns (especially in the case of semiwild cattle) and thus aid in holding the animal still.

So far as administering the doses is concerned, the position on the back (3) is by far the easiest in the case of sheep, and the side position with head down (4) is the easiest in dosing cattle; furthermore, in these positions there is much less danger of an accident by getting the dose in the lungs. If animals are dosed standing or on their haunches, the nose should never be allowed to go above the eyes; otherwise the drench may pass down the windpipe into the lungs.

By dosing sheep with water colored red and blue with dyeing material, and killing the animals immediately after the liquid was swallowed, the following results were obtained:

If the dose was given with the sheep standing (1), almost the entire quantity went directly into the fourth stomach; if the sheep was placed on its haunches, the fluid passed in part into the fourth stomach and in part into the first (the paunch); if the sheep was placed directly on its back (3), or if a steer was placed on its side (4) with head down, almost the entire dose passed into the first stomach (the paunch). If the animal, even when standing (1), struggled to a considerable degree, a portion of the fluid passed into the paunch.

It will be immediately apparent that these facts are of practical importance in dosing. If, for instance, gasoline, turpentine, or creosote is used, better results may be expected if the sheep is dosed standing (1).

PREVENTIVE MEASURES.

First. Every ranch should have a hospital pasture situated on high, dry ground, well drained, and without any pools or ponds; this should be supplied with raised troughs for watering and feeding, and the water supply should come from a well. This pasture should not drain into any pasture in which healthy stock are feeding.

Second. As soon as any sick animal is noticed in the large pasture it should be immediately separated from the healthy stock and taken to the hospital pasture. To allow sick animals to run at large with healthy stock means to deliberately permit the spread of infection in the pastures and thus endanger the uninfected animals.

Third. Proper watering places should be supplied in the large pastures by digging wells and erecting windmills to pump the water into tanks. These tanks should be raised above the ground so that they can not become contaminated with the animals' droppings being washed into them by rains and floods.

Fourth. Select high, sloping ground for pasture when this is possible. Low pastures should be properly drained.

Fifth. When practicable, burn the pastures regularly, thoroughly, and systematically. The heat from the burning grass will kill many of the eggs and young worms on the grass, ground, and in the droppings.

Sixth. As parasites are more fatal to young animals than to old, a liberal supply of oats or some similar food will aid in giving to young animals strength which will enable them to withstand the infection. A daily allowance of, say, half a pound of oats per lamb ought to reduce the mortality. At first they may not be inclined to eat it, but they will soon become accustomed to it. This simple precaution is reported as very effectual in New Zealand.

Seventh. Keep plenty of salt accessible to the animals. Some men add slaked lime to the salt; others add 1 part of sulphate of iron to 100 parts of salt. As a matter of experience, salt kills many young worms.

For the minute worms encysted in the fourth stomach, and also for those forming nodules in the bowels, no treatment is known.

For worms in the lungs, numerous methods of treatment have been suggested, and success has been claimed for certain remedies. None that we have tried, however, has proved satisfactory.

No practical medicinal treatment is known for the flatworms of the liver, and the treatment for tapeworms in the bowels of ruminants is frequently unsuccessful.

"BIG HEAD" OF SHEEP IN UTAH.

Frequent reports reached the Bureau of Animal Industry during the spring season of 1900 and 1901 of a disease affecting sheep in Utah and Idaho. This disease is known there as "big head." It appears to occur principally in the spring months, but is sometimes observed as late as July. The Bureau endeavored to secure some of the diseased heads for examination, but failed to receive any in condition suitable for microscopical work.

In June, 1901, Dr. H. M. Rowe, assistant inspector of this Bureau, was detailed to proceed to Pocatello and Soda Springs, Idaho, and make a careful investigation regarding the disease—its symptoms, course, postmortem lesions, probable cause, and economic importance, as well as the age, class, and condition of the animals affected. Dr. Rowe's report, under date of June 18, 1901, is as follows:

Symptoms.—The first symptom is a continuous licking of the lips from fifteen to thirty minutes; during the latter part of this time the animal holds its head up and points its nose, and after a few minutes longer turns the head from side to side. Its gait is staggering, and it becomes totally blind in from thirty to forty-five minutes from appearance of the first symptom, making it impossible for it to keep in the herd. It will walk against any other sheep, person, or object, finally dropping on the knees and rubbing the nose against the ground as if it were itching. After a few minutes in this position it lies down. The swelling of the head appears in from fifteen to thirty minutes after the first symptoms and within two hours the head is swollen to an enormous size; in the region of the throat it frequently attains a thickness of four or five inches. The ears first droop and then swell to the thickness of an inch; this swelling continues until the eyes are invisible and in some cases forced out on the cheek and are burst. The lips become so swollen that it is impossible for the animal to open its mouth. The breathing is difficult and quickened, with snuffling due to mucus in the nose; the temperature is elevated according to the severity of the case. The swelling is always very hot and does not extend more than three or four inches behind the ears. The hearing is not affected in any case.

I talked with one sheep owner who told me that, in skinning diseased sheep, he had noticed that infiltrated patches appeared on the body, but this observation was not verified by several others who were familiar with the disease, nor have I noticed it myself. The bowels do not seem to be disturbed, except that they are somewhat inactive, a condition probably resulting from the accompanying fever. The infiltration, which occurs about the head, consists at first of a serum, yellowish in color, and, as the disease advances, becomes mixed with blood and finally results in a thick colored pus. This pus is very sticky, making it necessary, at the beginning of the convalescent stage, to wash the eyes and lips with warm water, and apply vaseline or other greasy material. There is always a profuse discharge from the nose, and during the convalescent stage this has to be removed, on account of its sticky nature, to allow the animal to breathe more freely.

Course.—Cases that end fatally run from six to thirty hours.

Probable cause.—Among sheep owners there is a great diversity of opinion as to the probable cause—such as atmospheric influences, certain waters, gases emanating from the ground, insects getting into the nose, contagion, overheating, and poisoning by plants. After investigating the disease as best I could under the circumstances, the opportunities for which were somewhat limited, I am of the opinion that it is caused by a poisonous plant, basing this opinion upon the facts that the lips are the first parts affected and that the swelling extends backward from them. Almost every sheep owner is certain that he knows the localities where sheep, if driven through them, are attacked by this disease. In some of these localities it is observed that sheep are continually grazed with immunity from the disease, but when strange sheep are allowed to graze there they very soon become affected.

There is in Oregon an old sheep trail, known as the "Daley road," running east from Pilot Rock, over which hundreds of thousands of sheep are trailed, and along which some years ago the annual loss amounted to 65 per cent. The dangerous part of this trail begins about 6 miles east of Pilot Rock and is 14 miles long. The trail is on the top of a ridge, and sheep are continually grazing on its sides and in the valleys below. Men who continually graze their sheep on either side of this trail claim that if they drive sufficiently fast to heat them they will have big head, but the attack is not so severe as with strange sheep. The sheep owners in this locality even point out a plant which they claim is the cause of big head, but I have not had the opportunity of having it pointed out to me.

There is a small canyon near Wasatch, Utah, where, if sheep are driven through it, over one-half of the herds will become affected. There is very little grass here, but some weeds, and the soil is of a reddish brown clay.

Salina Canyon, near Salina, Utah, is another place where nearly all the sheep which are grazed there become affected; but there are hundreds of such places that could be named. One such place, near

Black Rock, which I have seen is covered with the poison sago lily, or wild sago lily; but in several places where the disease exists the poison sago does not grow.

Another reason that confirms my belief in the poison theory is that this disease makes its appearance in the early spring when vegetation is starting, and the plant is seldom, if ever, seen when dead. The disease is most common in April, May, and June, and is never seen on winter ranges, although a few cases may be seen between June and October. Many owners claim that the disease appears after a storm or a change in the weather, but just as many say that they have observed it during steady, unchangeable weather. I have known it to appear in sheep which had not tasted water of any kind (except snow) for a week.

Economic importance.—The actual loss of those affected runs from 1 to 65 per cent, but from the knowledge I have acquired during the past few months I would estimate the average deaths at about 17 per cent of those affected. The loss is augmented because of blindness; the sheep wander from the herd and are devoured by wild animals. The other principal loss is by ewes losing their lambs. Sheep which have had this disease will not begin to thrive until about three months after their recovery.

Age, class, and condition.—All ages are similarily affected, excepting lambs, which are very rarely, if ever, affected. The majority of sheep owners seem to think that wethers are more susceptible than ewes, and that ewes with lambs are less susceptible than ewes that are not, and fat sheep more than thin ones.

Postmortem.—I have not had an opportunity to hold a satisfactory postmortem.

Treatment.—Treatment differs in different localities. In southern Utah sheep are kept moving night and day, and an effort is made to keep them excited by borrowing all the available dogs and setting them upon the sheep. In almost every other locality in the West it is customary to allow the sheep immediate rest, and to make two slits in each ear to allow the serum to escape, severing the angular veins, and lancing the swelling beneath the lower jaw. Mr. J. D. Wood, who is probably the largest sheep owner in Idaho, told me that when he did this the loss was often reduced as low as 1 per cent; and after a rest of twenty-four hours he was usually able to proceed with his sheep.

BLOOD POISONING (MALIGNANT EDEMA) IN SHEEP AND LAMBS IN NEW ZEALAND.[a]

J. A. Gilruth, M. R. C. V. S.,
Chief Veterinarian for New Zealand.

This disease, which occurs during the operations of shearing sheep and of castrating and docking lambs, is the cause of considerable loss annually to sheep breeders in several districts of the colony. In 1893 a leaflet was issued dealing with the disease and the preventive measures to be adopted. Where my recommendations have been followed there has been little or no trouble, but it is apparent that many owners have not availed themselves of the services of the department by advising us in time, and losses have been considerable in consequence. Generally the first thing that draws the owner's attention seriously to the condition of his flock is the discovery, in from thirty-six to forty-eight hours after docking or shearing, of a few dead sheep lying in various parts of the paddocks. Next morning he finds a few more dead, and so on for three or four days, when, as a rule, the mortality ceases.

Symptoms.—On account of the gregarious habits of the sheep, an ailing animal, unless exhibiting very violent symptoms, is easily overlooked. In the early stages of this disease the animal seems listless, disinclined to move about, and, if the sun is shining strongly, prefers to lie in the shade. If forced to move, the hind legs are drawn forward with a peculiar stiff, dragging motion, as if there were no joints. There are slight muscular tremors all over the body, which become spasmodic as the disease progresses. If the flock be driven about much, the diseased animal soon shows signs of great fatigue, ultimately dropping to the ground thoroughly exhausted. The breathing is fast and painful, being maintained more by a series of spasmodic jerks than by any regular act. The pulse is quick and weak; the temperature is very high, registering 106° to 108° F., showing acute fever; the eyes close, and the whole face is expressive of pain. Gradually the spasms cease and coma sets in, resulting in death. The scrotum and surrounding skin right along the floor of the abdomen and between the hind legs become swollen and black. This gangrenous tissue, when present before death, can be peeled off without pain to the animal.

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[a] This paper was transmitted to this Bureau, through the Department of State, by Hon. Frank Dillingham, United States consul at Auckland.

On postmortem examination various conditions are met with. The animals are generally found to be among the best of the flock and in fairly good condition. The scrotal and perineal regions in lambs (between hind legs and below tail) are always, or almost always, gangrenous, this condition extending along to the floor of the chest, and sometimes implicating the tail. Many of the muscles, generally those of the shoulders, haunches, and loins, are dark in color and infiltrated with a black, watery fluid. The intestines are generally healthy, though sometimes the peritoneum is inflamed. The spleen and liver are in the usual condition after death, due to febrile disturbance. In the chest, either the pleuræ (coverings of the lungs) or pericardium (covering of the heart) are often inflamed, with occasionally a fibrinous exudation, causing the surfaces to adhere. The following description, by Mr. Reakes, Government veterinarian, of an outbreak in sheep after shearing, is fairly typical:

> At the end of December I received instructions to visit a station in the Mackenzie country, where serious mortality was occurring among sheep immediately after shearing. On arrival I found that, owing to the large number of deaths, shearing had been entirely suspended. About 4,000 sheep had been shorn, of which some 300 had died. I was informed that the affected animals exhibited the first symptoms in from twenty-four to forty-eight hours after being shorn, and usually lingered two or three days before dying. The first noticeable symptom was an edematous, rapidly spreading swelling, always in conjunction with and in proximity to a wound from the shears. It was noticed that if this occurred on the lower portion of the limb the animal frequently recovered, whereas if high up on the limb or on the under part of the body death was an invariable result. When these edematous swellings were incised during life, a clear, serous fluid exuded, but after death this fluid was blood stained. The swellings occasionally ruptured during life, discharging a portion, if not all, of the contained fluid, this being often followed by recovery. The sheep appeared dull, off feed, and semicomatose. The same trouble had occurred at shearing time for at least five years past, and in the preceding three years the mortality had been as heavy as was the case this year. Before commencing shearing the whole of the shed had been thoroughly washed out with a strong solution of Jeyes's fluid, the characteristic odor of which was obtrusively apparent on entering the building.
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> Previous to shearing, the whole of the sheep had been remarkably healthy, the total loss during the past year being only 2 per cent, these dying from shortage of feed and exposure during the winter. Everything pointed to a contamination of either the shed or yards (probably the latter) being responsible for the trouble. On this assumption I obtained four unshorn wethers, and inoculated each in the thigh with 5 c. c. of water in which earth from the surface of the yards had been stirred. The bulk of the solid matter was allowed to precipitate, and the muddy colored fluid injected. Next day all four were showing various degrees of lameness, with heat and swelling at the seat of inoculation. Some three days after one of these died, showing similar symptoms to the sheep infected after shearing. The remainder, after being sick some days, recovered. As a result of the investigation I strongly advised the owner to build an entirely new shed and yards at a distance from those then in use, a course which he expressed himself determined to follow. The remainder of his sheep were shorn at a neighbor's shed, no further trouble occurring.

Cause.—In my annual report for 1900 I have demonstrated the cause of blood poisoning to be a microbe known as the malignant edema bacillus (*Vibrion septique* of Pasteur). This organism, which is found in many dirty yards, swampy soils, etc., on gaining entrance to the system of almost any animal by means of a wound, rapidly increases in numbers, producing gangrene, or death, of the part affected first, and ultimately the death of the animal.

Curative treatment.—This is practically useless, being rarely successful, even in the human patient, where every care can be taken and expense is of no moment. Preventive measures can be adopted, however, and here much that is beneficial may be accomplished with the exercise of a little care and trouble.

Preventive measures.—Being organisms capable of producing spores (seeds), the bacilli have great resisting power, and in all probability may remain for years in the soil. The practice of leaving carcasses of animals dead of this disease lying on the paddocks to rot and to be torn to pieces by hawks is very pernicious. As a result fresh centers of infection are formed through the absorption of the bacilli by the earth, and probably the disease is spread to considerable distances by the carrion hawks, directly, through dropping portions of the flesh, and indirectly, possibly, through the bacilli passing out of the intestinal canal of the hawk, uninjured, among the feces. One means of prevention strongly indicated, therefore, is the destruction of the carcasses of animals which have succumbed to this disease by efficient burial or by fire. It would appear that in most instances the contagion is present in the yards or surroundings of the wool sheds, and is consequently extremely difficult to get rid of. In order to do so it would be necessary to employ some means, such as the following: Remove the surface soil of the yards and surroundings to a depth of about 6 inches and place in a heap, where it should be thoroughly mixed with quicklime. Then saturate the fresh surface exposed with a strong solution of crude carbolic acid or of some nonpoisonous disinfectant sheep dip, that which remains after the usual sheep-dipping operations, where such a dip is employed, being admirably suited for such purpose. It would be advisable, also, thoroughly to clean the floors and walls of the sheds, and apply strong hot lime wash, with which should be mixed some powerful disinfectant, such as crude carbolic acid in the proportion of 1 to 50. Along with the above precautionary measures it is absolutely necessary to adopt some means of preventing the germs from gaining entrance into the flesh cuts made by the shears or the docking or castrating knife. In the shearing shed it should be imperative that the shearer on making a cut, especially in the region of the breast or legs, should immediately apply some tar or other antiseptic to the wound. This practice is in force in several sheds with distinct advantage, but in many no precautions whatever are taken. For lambs at docking and castrating time I recommended, seven years ago, the application of carbolized oil to the wounds on the scrotum and tail before releasing the animal after the operation, and where this has been acted upon the benefits have been marked. Docking and tailing knives should be boiled before use. In several instances this disease has been prevented from occurring in lambs through castrating in temporary yards made of movable hurdles situated in a fresh paddock; but I have known cases where this was to be found in the adjacent swamps, where probably in former years animals had died of the same disease, and, the carcasses being left to rot, the water had gradually disseminated the germs throughout the swampy area. The lambs, feeling weak from loss of blood, had taken to the shelter of the long tussocky grass growing in these swampy areas, and the wounds coming in contact with the infected ground had become contaminated. This demonstrates the necessity for using antiseptic applications even when temporary yards are employed, and for keeping sheep and lambs after the operation in a paddock free from swampy patches.

FEDERAL INSPECTION OF FOREIGN AND INTERSTATE SHIPMENTS OF LIVE STOCK.

By D. E. Salmon, D. V. M.,
Chief of Bureau of Animal Industry.

The stockmen of the United States have built up one of the greatest industries that has ever been established by the labor and perseverance of mankind. It is an industry which extends from the forests of Maine to the wheat fields of Oregon, and from the Great Lakes on our northern border to the Gulf and Rio Grande on the south. It represents not alone the efforts, self-denial, and endurance of this generation, but also the magnificent achievements of our fathers and grandfathers.

The meeting of the International Live Stock Association, which was held at Chicago last November, was the means of bringing together the very finest specimens, or, as the French would say, the cream of the cream, of all the breeds. It was indeed a great opportunity to observe the traffic of the wonderful market at Chicago and to appreciate the perfection to which our breeders have brought the leading types of horses, cattle, sheep, and hogs. At the sales of purebred stock in Chicago, buyers stand ready to pay $1,000 or even $5,000 for a single animal, and one is impressed as nowhere else with the magnitude and value and importance of the live-stock industry. But Chicago is not the only market where such transactions can be witnessed. Similar products of the farm and ranch are pouring in a continuous stream into the markets of San Francisco, Denver, Fort Worth, New Orleans, Kansas City, St. Joseph, Omaha, Sioux City, St. Paul, Milwaukee, St. Louis, Louisville, Cincinnati, Pittsburg, Cleveland, Buffalo, Boston, New York, Philadelphia, Baltimore, Richmond, Atlanta, and many other cities. It is only by looking upon the busy scenes of these great centers of trade that we can realize the great aggregate of the American live-stock industry and the tremendous volume of interstate and foreign commerce which flows from it.

Where are the sources of these streams of animals which flow into the Chicago stock yards? Very few, comparatively, originate in the State of Illinois; the great majority come from other States—Wisconsin, Minnesota, the Dakotas, Montana, Idaho, Wyoming, Nebraska, Iowa, Kansas, Colorado, Texas, and even far-away New Mexico and Arizona. There is seen at Chicago not merely a local trade, not a trade affecting only the one State of Illinois, but the trade of the nation. The Chicago stock yards is one of the principal channels of our interstate commerce. If the natural and easy flow of this commerce is blocked or obstructed or made more difficult or expensive, the effect is felt as quickly and as seriously in Idaho, Wyoming, Colorado, or Arizona as in Illinois. There never has been a time in the history of the world when distant sections have been brought so close together by rapid transportation and quick communication as they are to-day, and consequently there has never been a time when the remotest sections of our country participated to the same extent in the nation's commerce or when they were as interested as now in having that commerce everywhere and at all times free from unnecessary restrictions and burdens.

The volume of the interstate and export traffic in animals and their products at this time is so large that it is incomprehensible. We have figures that represent it with comparative accuracy, but few minds can grasp the significance of these figures or appreciate their bearing upon the welfare and prosperity of the country as a whole. That this enormous trade is essential to the best interests, not only of the live-stock industry, but of transportation companies, stock-yard companies, banks, merchants, and other allied business enterprises, reaching and acting upon all parts of our social fabric, can be demonstrated by a few figures. There were received at the one stock yard of Chicago last year, in round numbers, 99,000 horses, 2,900,000 cattle, 3,500,000 sheep, and 8,000,000 hogs. If these animals could be gathered together on the roads of the country, the horses going ahead two abreast, as ordinarily driven, and the cattle, sheep, and hogs following them in the same order, it is estimated that there would be a solid block of animals 5 feet wide and 5,000 miles long. At the rate of 3 miles an hour for eight hours a day it would require eight months for this procession to pass. Such is the trade of the Chicago market alone.

Another illustration of this subject is drawn from the figures of the Federal meat-inspection service. This inspection is applied to the carcasses of animals slaughtered for the interstate and foreign trade. It is maintained in 51 cities and at 156 slaughtering establishments. There were inspected in this service last year 5,600,000 cattle, 6,600,000 sheep, and 24,600,000 hogs. The total number of animals inspected at time of slaughter during the year was, in round numbers, 37,000,000. This will give an idea of the meat-inspection work of the Bureau of Animal Industry, and at the same time it pictures the vast dimensions of the interstate and export trade in animal products at the present day.

Our export trade in animals and animal products is conducted on the same immense scale, and the few figures following will serve to show how large it is and of what it consists. Last year we exported, in round numbers, the following: Cattle, 459,000, worth $37,500,000; horses and mules, 116,600, worth $12,000,000; sheep, 298,000, worth

$1,900,000. The total exports of live animals, including fowls, were valued at $52,058,876. In addition to live animals, we exported the following animal products: Of meats of various kinds, $113,778,113; animal fats and oils, $66,518,176; dairy products, $9,403,722; miscellaneous animal products, $12,129,859. The grand total of animals and animal products exported during the year reached a value of $253,-888,746—over a quarter of a billion of dollars. After increasing our breeding stock, after feeding our 76,000,000 of people, this is the surplus product of the live-stock industry which we sent to the markets of other lands. It is more than the total exports of this country in any one year previous to 1856.

The above figures are more eloquent than words, and it is vain to undertake to enlarge upon them or to make their meaning more apparent. They show in the clearest light the heritage that is the stock raiser's—his to enjoy, his to profit by, his to hand over unimpaired to the succeeding generation. It is something more than a mere possession; it is a trust, upon the proper administration of which depends the welfare of succeeding generations.

What is the Government doing in the way of inspection to protect and facilitate this enormous traffic? The extent of the meat inspection which is maintained in order to prevent the shipment of diseased and unwholesome meat from one State to another or to foreign countries has already been shown, but it may be stated here that this inspection is conducted for two purposes—to protect the health of the consumer and to uphold the reputation of our meats. In addition to this, there is an inspection of the live animals which go abroad and of the ships which carry them. Export cattle are inspected and marked with metal tags in their ears in the stock yards. These are then loaded in clean cars, and their shipment is officially announced to the inspectors whose stations they will pass on the way to the seaboard. Their coming is, therefore, expected at each station on the route, their handling is watched, and they go under strict and constant supervision to their places on the ocean steamship. The Government certifies that these cattle are free from contagious disease, that is, that they are neither diseased nor have been exposed to disease. Horses and sheep are inspected in very much the same manner.

It is also necessary to inspect the vessels in order to ascertain that they are free from infection, since all of these vessels go to foreign ports and may there take on board animals or hides or other products liable to carry contagion. It is also found desirable to supervise the fitting of these ships, to require the pens and stalls to be of sufficient size, the framework strong enough and properly fastened to the decks, the alleys of proper width, the ventilation ample to insure against suffocation, the feed and water supply sufficient for the voyage, and the number of attendants such that the animals may be regularly fed and watered. It is only by the rigid enforcement of these regulations that it has been possible to hold the trade. Last year a thousand ships carrying live stock were inspected and allowed to clear from the ports of the United States, having complied with the requirements. To illustrate something of what has been accomplished by this inspection for the benefit of the live stock industry, it may be said that not only has the trade been preserved, but it has been increased, and the reduction of insurance on the cattle alone is more than twice as much as the whole appropriation for the Bureau of Animal Industry.

The Government also inspects animals coming into this country, in order to guard our live stock so far as possible from imported contagion. It maintains quarantine stations at the principal ports, where cattle from most parts of the world are detained for three months and where other animals are held for fifteen days. There were 1,165 farm animals quarantined during the last year and 116 menagerie animals.

It is extremely important at this time that every precaution should be taken to keep out disease, because with foot-and-mouth disease and pleuropneumonia prevalent in Europe, with South Africa overrun with rinderpest and pleuropneumonia, with South America harboring foot-and-mouth disease, with pleuropneumonia existing in Australia, and with rinderpest and foot-and-mouth disease reported from the Philippines, we are now almost surrounded with these destructive plagues, and it would appear that nothing less than eternal vigilance can preserve us from them.

If foot-and-mouth disease or rinderpest should appear among the cattle of the United States, we would at once lose our export trade in live animals, worth $50,000,000 a year, as Argentina lost hers, and we might also lose our meat trade, worth $100,000,000 a year. In addition, we should have the ravages of these diseases and a disheartening struggle of years to rid ourselves of the contagion. But notwithstanding these dangers there are people of influence and intelligence who insist on bringing animals from the worst infected countries, and who rave over the inconvenience of quarantine as though their little personal interests were alone to be considered.

In this connection a few words may be said concerning tuberculosis, the writer fully realizing the difference of opinion which exists among breeders, and the prejudice which has been established by exaggerated and false reports concerning the action of the Department of Agriculture. The best authorities in Europe, after having had experience with pleuropneumonia, foot-and-mouth disease, and rinderpest, tell us that tuberculosis, when it has once thoroughly permeated the herds of a country, causes greater losses in a series of years and is more difficult to control than any other disease of animals. In some of the European countries over 30 per cent of the slaughtered cattle are tuberculous, and the loss from condemned meat, loss of flesh in the living animals, and shrinkage of the milk are enormous. In the United States, with the same number of diseased animals, the loss would be far heavier, because our people will not eat diseased meat, as they do in Europe. With the most liberal views which would be tolerated in this country concerning the fitness of tuberculous carcasses for edible beef, it would be necessary utterly to condemn and destroy from one-third to one-half of the affected carcasses. We now destroy about 5,000 carcasses a year, worth about $250,000, but if tuberculosis were as prevalent here as in Europe, we should be compelled to destroy, at the lowest estimate, 650,000 carcasses, worth $32,500,000. But this is not all, for it is proved beyond question that tuberculosis in hogs increases in direct proportion to tuberculosis in cattle; and if we had but 6 per cent of tuberculous hogs and were compelled to condemn half of them, the loss would be over $7,500,000. In addition to this loss of meat, amounting to $40,000,000 a year, we would be compelled to suffer the loss of thoroughbred and dairy stock, and the shrinkage in flesh and dairy products which it is impossible to estimate, but which would certainly be a large sum. Now, laying aside all prejudice and preconceived opinions, and looking at this as a business proposition, is it not worth our while and is it not our duty to try every means in our power to avoid the establishment of conditions here which would inevitably bring such a loss upon us?

There is no fact better established to-day than that tuberculosis is a communicable disease. Every diseased herd, every diseased animal, is a center from which the disease may spread. For a few years past this country has been the dumping ground for tuberculous cattle from Great Britain and Canada. When the Bureau of Animal Industry began testing Canadian cattle through its own inspectors, it found that 25 per cent of the purebred stock offered for importation responded to the test, while in some of the British herds 60 per cent was found affected. If we continue to admit such cattle, how long will it be until our herds are as badly diseased as the European herds? This is one of the most important questions now before stockmen. It is one which vitally affects their welfare, and it is one which they can not afford to have decided by the very few men who are interested in the importation of diseased cattle or who favor it for any other reason. It was said fifteen years ago, when there was so much trouble and loss from pleuropneumonia, that the cattle of this country were as good as any in the world, and that we should follow the example of Great Britain and exclude foreign cattle from our territory. The writer did not think our live-stock industry was prepared for such a radical policy at that time; but our advance has been immeasurable, and to-day we are in a position to maintain and improve the herds of all the valuable breeds without the addition of fresh blood from foreign lands. We are saying to the countries on the south of us, and truthfully, that they can buy as good cattle here, and often better ones, than they can in any other part of the world. Then why should we continue these importations, which are of doubtful benefit and often injurious?

In addition to the purebred cattle, there were imported under Federal inspection from Canada 40,000 cattle, 200,000 sheep, and 3,200 horses, and from Mexico, 100,000 cattle, 2,700 sheep and goats, and 100 horses.

In the interstate inspection the Federal Government has a service to prevent the spread of sheep scab, and in this service 8,000,000 sheep were inspected, and more than 1,000,000 were dipped under the supervision of the inspectors because they were diseased or had been exposed. There is another service to prevent the spread of Texas fever, and in this service 1,169,000 cattle from the fever district were inspected and shipped under supervision and quarantine regulations for slaughter, while 307,000 cattle, which originated in Texas outside of the fever district, were inspected and permitted to be moved north for grazing.

This is a brief résumé of the inspection work of the Bureau of Animal Industry. The purpose of this paper is to show the extent to which the Federal Government has acted in this matter, and how completely it has covered all branches of interstate and foreign commerce which need regulation. Notwithstanding this complete and efficient service, some of the States have duplicated this interstate inspection of cattle from the South and Southwest. They have not only provided that the State inspectors shall inspect cattle coming into those States, but also cattle which are going across their territory for other States beyond their boundaries. And they have gone beyond the mere inspection, and have levied a tax or inspection fee upon the cattle inspected. This action, and particularly the tax, is a great burden to the trade, and it is a serious blow to the cattle industry of the South, already handicapped by the presence of the fever district. The State inspection is unnecessary; the Federal inspection is at least as good as that of any of the States, and the States which have established this inspection are fully protected by the Federal inspection.

There is no question of greater importance before cattle raisers at this time than what shall be done with reference to the attempts of individual States to regulate and restrict and burden interstate commerce in animals and animal products. The extent to which States may go in this direction is a question which in one form or another is as old as our Government. It vexed and troubled our forefathers, and it was one of the principal factors which led to the downfall of the form of government known as the Confederation, which existed during the Revolutionary war and for several years afterwards. Case after case has been decided by the Supreme Court of the United States in unmistakable language, but still State restrictions and State taxes are imposed, and it is found that some new aspect of the question is presented which demands consideration on its own merits.

When these State laws for the inspection of interstate shipments of live stock and the levying of fees for such inspection were first brought to the attention of the Department of Agriculture, the inspectors of the Bureau of Animal Industry were instructed that such laws were probably unconstitutional, and that they should not assist in their enforcement or in the collection of the fees. They were further instructed to advise shippers that they could probably obtain relief by going to the courts. These instructions have aroused great indignation in certain quarters, and it will be of interest to state as briefly as possible the reasons for taking this action.

Mr. Webster, who did so much in his day to expound the Constitution, is reported in 9 Wheaton, page 11, as having held in his argument before the Supreme Court in the celebrated case of Gibbons *v.* Ogden that—

> Few things were better known than the immediate causes which led to the adoption of the present Constitution; and he thought nothing clearer than that the prevailing motive was to regulate commerce, to rescue it from the embarrassing and destructive consequences resulting from the legislation of so many different States, and to place it under the protection of a uniform law. The great objects were commerce and revenue, and they were objects indissolubly connected. * * * The States could still [that is, under the Confederation] each for itself regulate commerce, and the consequence was a perpetual jarring and hostility of commercial regulation. * * * Over whatever other interests of the country this Government may diffuse its benefits and its blessings, it will always be true, as matter of historical fact, that it had its immediate origin in the necessities of commerce; and for its immediate object, the relief of those necessities, by removing their causes, and by establishing a uniform and steady system. * * *
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> We do not find in the history of the formation and adoption of the Constitution that any man speaks of a general concurrent power in the regulation of foreign and domestic trade as still residing in the States. The very object intended, more than any other, was to take away such power. If it had not so provided, the Constitution would not have been worth accepting.

Mr. Webster could not have made the case clearer if he had had in mind the State regulations which are now irritating and injuring the stockmen of the West. In a recent case the Supreme Court said: "What, however, is a proper quarantine law—what a proper inspection law for cattle—has not been declared. Under the guise of either, a regulation of commerce will not be permitted. Any pretense or masquerade will be disregarded and the true purpose of a statute ascertained." (Missouri, Kansas and Texas Railway *v.* Haber, 169 U. S., 613.)

While, therefore, it has been clearly decided that a State has no right directly and avowedly to regulate interstate commerce, or to accomplish this purpose under the guise of inspection or quarantine laws, there remains a question as to how far a State may go in indirectly regulating commerce through this class of legislation.

The court has plainly said in the words just quoted that, if the purpose of the law is the regulation of commerce, either an inspection or a quarantine law would be declared unconstitutional. But how is the purpose of the law to be determined? and to what extent may a legitimate inspection and quarantine law be permitted to regulate commerce? These are now the important questions, and the effort will be made to give, in a few words, the attitude of the court toward them.

A Minnesota statute required, as a condition of sales in that State of fresh meat for human food, that the animals from which such meats were taken shall have been inspected in Minnesota before being slaughtered. Of this the court said: "When to this is added the fact that the statute, by its necessary operation, prohibits the sale in the State of fresh beef, veal, mutton, lamb, or pork from animals that may have been inspected carefully and thoroughly in the States where they were slaughtered, no doubt can remain as to its effect upon commerce among the several States. It will not do to say—certainly no judicial tribunal can with propriety assume—that the people of Minnesota may not, with due regard to their health, rely upon inspections in other States of animals there slaughtered for purposes of human food." (Minnesota *v.* Barber, 136 U. S., 313.)

Of a Virginia statute requiring the inspection of flour it was said:

> The law in question is a discriminating law, and requires the inspection of flour brought from other States, when such inspection is not required for flour manufactured in Virginia. This aspect of the case brings it directly within the principle of Brimmer *v.* Rebman, 138 U. S., 78, decided at the present term. The law in question in that case was another statute of Virginia, making it unlawful to sell within the State any fresh meats (beef, veal, or mutton) slaughtered 100 miles, or over, from the place at which it might be offered for sale, until it had been inspected and approved as provided in the act. Mr. Justice Harlan, delivering the opinion of the court in that case, said:
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> "Undoubtedly, a State may establish regulations for the protection of its people against the sale of unwholesome meats, provided such regulations do not conflict with the powers conferred by the Constitution upon Congress, or infringe rights granted or secured by that instrument. But it may not, under the guise of exerting its police powers, or of enacting inspection laws, make discriminations against the products and industries of some of the States in favor of the products and industries of its own or of other States. The owner of the meats here in question, although they were from animals slaughtered in Illinois, had the right, under the Constitution, to compete in the markets of Virginia upon terms of equality with the owners of like meats from animals slaughtered in Virginia or elsewhere within 100 miles from the place of sale. Any local regulation which in terms or by its necessary operation denies this equality in the markets of a State is, when applied to the people and products or industries of other States, a direct burden upon commerce among the States, and therefore void." (Voigt *v.* Wright, 141 U. S., 62.)

The lower courts have also held that "A State inspection law, so called, which is in fact a law taxing articles of interstate commerce for the benefit of the State treasury, is unconstitutional." (Re Refman (U. S. Cir. Ct., Va.), 3 Inters. Com. Rep., 126; 41 Fed. Rep., 867.)

Also that the "Colorado act of 1889, concerning the inspection, before slaughter, of certain animals intended for human food, is in violation of the United States Constitution in so far as such act provides that fresh meats, sound, healthy, and fit for human food, can not lawfully be shipped into Colorado until inspected and certified as provided by statute." (Schmidt *v.* People, 18 Colo., 78; 31 Pac. Rep., 498.)

Also that "The provisions of Missouri Revised Statutes, 1889, secs. 953, 954, prohibiting transportation through the State of any Texas, Mexican, Cherokee, or Indian cattle affected with Texas, or Spanish, fever, are in conflict with the provisions of the United States Constitution, as an attempt to regulate interstate commerce, and are therefore void." (Selvege *v.* St. L. & S. F. R. Co., 135 Mo., 163; 36 S. W. Rep., 652.)

From these decisions we can legitimately conclude that, while States may enact inspection laws, such laws must not discriminate in favor of or against any State; they must not prohibit subjects of commerce which have been inspected in the State of origin and found free from objection, and much less, one would suppose, may they exclude subjects which have been inspected under the laws of Congress and for which a permit has been officially granted; they must not tax articles of interstate commerce for the benefit of the State treasury; they must not prohibit transportation through the State of any Texas, Mexican, Cherokee, or Indian cattle; they must not "exclude without discrimination, the good and the bad, the healthy and the diseased, and to an extent beyond what is necessary for any proper quarantine." (Smith *v.* St. Louis and Southwestern Ry. Co., 181 U. S., 248.)

In the quarantine cases relative to human diseases the State laws have been upheld, and these decisions are generally cited as sustaining the cattle quarantines. The position of the court here has not been inconsistent with the decisions already cited, and it is fully explained by the following quotation:

> In this latter case (Morgan *v.* Louisiana, 118 U. S., 455) certain quarantine laws of the State of Louisiana were upheld, although to a certain extent they affected commerce with foreign nations, the court saying: "It may be conceded that whenever Congress shall undertake to provide for the commercial cities of the United States a general system of quarantine, or shall confide the execution of the details of such a system to a national board of health or to local boards, as may be found expedient, all State laws on the subject will be abrogated, at least so far as the two are inconsistent."

That is, the court makes no exception of inspection or quarantine laws. Mr. Justice Strong said, in delivering its opinion, that a State may not, "under cover of exerting its police powers, substantially prohibit or burden either foreign or interstate commerce."

It has also been said in favor of the validity of the State laws that "a statute of Kansas, however, which made any person who shall drive or ship into the State any cattle liable or capable of communicating Texas, splenetic, or Spanish fever to any domestic cattle of the State liable for damages," was held not to be a regulation of commerce. It was also held that the statute was not repugnant to the act of Congress of March 29, 1884, known as the "Animal industry act." (See original decision M. K. & T. R. Co. *v.* Haber, 169, U. S., 613.) But there is a great difference between making a person who brings diseased cattle into a State liable for damages, on the one hand, and, on the other, prohibiting cattle which have been inspected and certified by Federal officers as free from disease. There is a great difference between the shutting out of diseased cattle and the requirement that healthy cattle shall be taxed with an inspection fee; there is a great difference between concurrent legislation to assist in carrying out the purpose of the animal industry act and legislation which conflicts with and is hostile to the Federal regulations.

Of just such cases the Supreme Court has said (quoting from case cited): "And it is also true, as conceded in that opinion, that Congress has the same right to regulate commerce among the States that it has to regulate commerce with foreign nations, and that whenever it exercises that power all conflicting State laws must give away, and that if Congress had made any regulation covering the matter in question we need inquire no further." (Minn. *v.* Barber.) And again: In case of such a conflict the State law must yield. "This Constitution, and the laws of the United States which shall be made in pursuance thereof * * * shall be the supreme law of the land." It is no answer to say that in this case the defendant might have complied with both the State and the national statute; that it was a party to the reduction of the joint rate; that, therefore, the bill of lading was properly issued at 69 cents per hundred pounds; that it should have promptly notified its agents at every station of such reduction; that if it had done so the agent at Cameron could have complied with the State as well as the national law; and that its negligence in this respect is sufficient ground for holding it amenable to the State law. The question is not whether, in any particular case, operation may be given to both statutes, but whether their enforcement may expose a party to a conflict of duties. It is enough that the two statutes operating upon the same subject-matter prescribe different rules. In such case one must yield, and that one is the State law. It may be conceded that were there no Congressional legislation in respect to the matter, the State act could be held applicable to interstate shipments as a police regulation." (Gulf, Colo. and Santa Fe Rwy. *v.* Hefly, 158 U. S., 98.)

Now let us turn to the regulations of the State of Colorado, and we will find that all cattle from the States of Texas and California and the Territory of Oklahoma, or from any portions of any other State or Territory below the thirty-sixth parallel of north latitude, without regard to the existence of any contagious disease in those areas, must be inspected before entering the State, and are subject to an inspection fee of 1½ cents per head. Is not this a clear discrimination against certain States and Territories of the United States? Is it not a direct burden upon commerce between the States? Does it not exclude without discrimination the good and the bad, the healthy and the diseased, and to an extent beyond what is necessary for any proper quarantine?

Examine this Colorado regulation still more closely and we find that the owner of healthy cattle, living in an uninfected part of Texas, who has his cattle inspected, certified as healthy, and is given a permit to move them to any part of the United States, is prohibited from crossing the State of Colorado with his cattle until they are inspected and taxed by the State officials. Is not this going beyond what is necessary for the protection of Colorado cattle from disease? Is it not in plain conflict with the laws of Congress and the regulations made to carry these laws into effect? Is it not another case of two statutes operating upon the same subject-matter and prescribing different rules?

Although the act of Congress specifically provides that Texas fever "shall not be considered a contagious infection or communicable disease as to cattle shipped by rail for slaughter," etc. [exact quotation], thus guaranteeing the South an outlet for its cattle at all seasons of the year, this Colorado regulation provides that cattle from all parts of Texas, whether infected or uninfected, whether for grazing, feeding, or immediate slaughter, whether moving by rail or trail, whether destined for Colorado or going through by rail without stopping, whether accompanied by a Federal certificate of health and permit to go to destination or not—this regulation, let it be repeated, provides that they shall be inspected before crossing the Colorado line, and that a tax of 1½ cents per head shall be levied.

If the attempt were made to combine in one regulation all the objections which the Supreme Court has pointed out in all of the States' statutes which have been pronounced repugnant to the Constitution and encroachments on the power of Congress to regulate interstate commerce, it is difficult to see how this could be accomplished any more effectually than in this regulation. If one State can confer such laws every State can, and every State will be obliged to do the same in order to obtain its share of the revenue collected from interstate commerce; if inspection and inspection fees can be enforced against Arizona, New Mexico, and the uninfected part of Texas, they can be enforced against every State in the Union; if Colorado can tax Texas cattle on their way to market, then Colorado cattle may be taxed first by Kansas, then by Missouri, then by Illinois, Indiana, Ohio, Pennsylvania, New Jersey, and New York on their way to the seaboard market.

In conclusion, let reference be made once more to the words of Webster, in which he depicted so graphically the reasons for the adoption of the Constitution, showing that the principal one was to rescue commerce from the embarrassing and destructive consequences resulting from the legislation of so many different States and to place it under the protection of a uniform law. He had studied this matter thoroughly and he believed that if the Constitution had not taken away the power of the States to regulate foreign and domestic trade, that Constitution would not have been worth accepting. If that were true in 1787, with thirteen States on the Atlantic seaboard constituting the Union—without railroads, without steamships, with a comparatively insignificant traffic—how much more reason is there for adhering strictly to this principle at the present day. If the laws of thirteen States caused confusion, irritation, derangement, and destruction of trade, what will happen if forty-five States now begin to legislate upon this one subject? And if the consequences of State regulation were so disastrous at that time, what less can we expect to-day?

Many remember the time when the local butchers gathered up most of the beef cattle, killed them in the localities where they were raised, and peddled out the meat to the consumers. There were no great stock yards like those which are now seen at Chicago; no great packing houses like those which daily slaughter cattle by the thousand; no train loads of cattle gliding day and night over rails of steel from the ranches a thousand miles away; no refrigerator cars to carry the product to the remotest parts of the nation. What a transformation in the course of a single lifetime! California is brought nearer to New York in point of time than was the District of Columbia in the early days of our Government. These great changes have served to multiply interstate traffic.

The writer has endeavored in this paper to give an idea of the enormous volume of our domestic and foreign trade in animals and their products, but the half has not been told because the figures are not accessible. Enough has been seen, however, to convince us that there has never been a time in the history of our country when the trade has been so large and so valuable as it is now, nor a time when it has been anything like as important to keep this trade free from unnecessary restrictions and burdens of every kind.

The stock raisers deservedly have great influence in directing the policy of this country in such matters. The officials at Washington are their servants. It is said by many that these stock raisers and the Washington officials are not in touch with each other, that there is no community of thought or action; but let us pledge ourselves now to work together and thus save this great industry from the thoughtless and mistaken but no less dangerous restrictions of the individual States. Let it not be said that in this progressive and intelligent country, in the twentieth century of the Christian Era, a carload of cattle could not be shipped from New York to California without being held up at the border line of ten different States and taxed an inspection fee by ten different inspectors. If we permit that we are unworthy of the great trust which has been confided to us.

FOOD PRODUCTS FROM DISEASED ANIMALS.[a]

By D. E. Salmon, D. V. M.,
Chief of Bureau of Animal Industry.

What effect may the food products from diseased animals have in disturbing the digestion and in causing more serious diseases in the human consumer? This is a question easily asked, and dismissed by many with the same facility; but who can supply the data that will convince the mind of the earnest student of dietetics?

From my point of view the subject is one which has been sadly neglected. There are few who stop to consider the millions of cattle and sheep, the tens of millions of hogs, and the hundreds of millions of birds consumed as food in this country every year. To watch the arrivals of such animals at one of our great packing centers for a single day fills one with a feeling of amazement at the enormous development of the stock-raising industry and at the tremendous amount of animal food which our people require. But what we have seen at any one point is but a small part of what has been done at all of the fifteen or twenty packing centers. And this great flow of live animals from the farm to the abattoirs is as constant as our great rivers, and more uniform. It goes on night and day, with only moderate variations as to quantity, every month and every week and every day of the year.

Now picture in your minds for a moment the great flow of dairy products—of milk, of butter, and of cheese—from the farms and creameries and factories to the consumers—the product of more than sixteen millions of cows. If these streams of nutritive material are liable to contamination, how important it is that they should be guarded at all material points!

Unfortunately, animals are subject to a large number of diseases, from the simplest functional disorders to the most serious organic changes, and to the most deadly forms of contagion. The great scientific activity of the last quarter of the century just past has served to clear up the pathology of many of these diseases, and the educated veterinarian now knows the nature of the diseases which he sees, and can appreciate fairly well the effect of various pathological conditions upon the products of the affected animals. But outside of the veterinary profession, with comparatively few exceptions, the knowledge of animal pathology is fragmentary; the ideas concerning it are vague, distorted, and misleading; the notions as to the details of sanitary precautions are crude, impracticable, and insufficient. It is for this reason that I venture to introduce the subject at this meeting, and treat it in an introductory manner.

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[a] Read at the meeting of the American Medical Association, held at Minneapolis, Minn., June 4-7, 1901.

The Federal meat-inspection service has been by many misunderstood and misrepresented. It is a sanitary inspection rather than a commercial inspection. It is applied to meats shipped from State to State as well as to foreign countries. The first object of the inspection is to protect the health of the consumer. The one part of this inspection system, which is made primarily for commercial reasons, is the trichinæ inspection, which is applied only to pork intended for shipment to certain countries which require such an inspection. The trichinæ inspection is, however, but a small part of the Federal meat-inspection service, and should not be permitted to obscure the efforts made in the general inspection service to protect the health of our own citizens.

The great difficulty in meat inspection is where to draw the line between meat that shall be passed as fit for food and that which shall be condemned. Of course, there are many carcasses with which there is no such question raised; the great majority are unquestionably good or unquestionably bad. But between these extremes there are all shades of gradation. I once saw a health officer condemn a number of fine carcasses of beef because he discovered in the animals' intestines a few cysts containing cheesy matter which he thought was actinomycotic, but which were really caused by a minute animal parasite, and which affected the quality of the beef no more than would a wart upon the animal's skin. At the same time there was hanging in a conspicuous place in the slaughterhouse a carcass of beef affected with generalized tuberculosis, and literally filled with small tubercles, which was allowed to go into consumption. If the gentleman who passed upon these carcasses had been solely selected because of his knowledge of pathology, he would undoubtedly have reversed his action and condemned the tuberculous carcass without interfering with that showing the verminous nodules in the intestines.

But it is not alone ignorance that we have to contend with. Sanitary questions are complicated with questions of fraud. For instance, the flesh of dogs is esteemed by the people of some countries, and, so far as I am aware, it is nutritious and not injurious. An American meat inspector could not allow the sale of dog meat, however, because it is repugnant to our people, would not be purchased and consumed if its nature were known, and its sale would constitute a fraud. The flesh of horses and mules, which is eaten in civilized countries to a much greater extent than that of dogs, is nevertheless often condemned with us because it is usually sold in a fraudulent manner as the flesh of cattle.

The flesh of goats is probably in most cases sold as mutton, but it is not likely that the carcasses are ever condemned for that reason. These examples are mentioned to make clear the arbitrary manner in which the flesh of some species of animals is often condemned, while that of other species, also sold fraudulently, is allowed to go to the consumer without protest. These are questions of habit and custom rather than of sanitation.

Let us go a step further and briefly consider the question of special physiological condition of the animal at the time of slaughter. The meat of an old boar or a stag (boar castrated after becoming adult) has a strong, offensive taste and odor, and is likely to cause loss of appetite and possibly nausea in the delicate and sensitive consumer. Should such meat be invariably condemned? Probably not, because there are consumers who are neither delicate nor sensitive about such matters, and who prefer to use such meat because it is sold at a lower price, while the odor and taste reveal its nature to those who object to it.

It is by no means infrequent that female animals in an advanced stage of gestation, just ready to drop their young, are found in the slaughterhouses. In most countries these are not interfered with by the sanitary authorities, but the Federal inspectors are instructed to condemn them and prevent their slaughter for human food. I have often been asked to give my reasons from a sanitary point of view for this course. My justification is placed, first, on the ground that a consumer would not knowingly purchase such meat and that its sale is as much a fraud as is that of horse meat; and, secondly, that while the animal is, strictly speaking, in a physiological condition, it is not in its usual physiological condition, nor is the change one which is calculated to improve the quality of the meat. The respiration of the fetus throws a large quantity of waste products into the blood of the mother. In the preparation for parturition the circulation is disturbed; there are material morphological changes in the reproductive organs and parts connected with them; some of the liquids of the body—as, for example, the milk—are considerably changed in composition. The flesh of an animal in this condition is, in my opinion, objectionable, although I do not know of any cases in which it has injured the consumer.

It is desirable that the shipment of animals advanced in pregnancy for slaughter should be discouraged, since they are more liable to injury than others, the fetus being often found dead, and frequently more or less decomposed. In such cases there may be considerable inflammation of the uterus and absorption of septic material. The carcasses of such animals must, of course, be condemned. For these reasons inspectors of the Bureau of Animal Industry are instructed to condemn all animals which are within two weeks of the time of parturition.

Females in which parturition has recently occurred are also condemned as unfit for food. It is astonishing to see how many calves, lambs, and pigs are dropped en route or in the stock yards. Sometimes this happens as the animals are on the way to the killing floor. Often parturition is hastened by bruises, crowding in the cars, fright, or other causes. In this case there is more disturbance of the mother's health—weakness, retention of the membranes, offensive discharge, feverishness, and septic absorption. Such animals are not in the condition to produce a safe and wholesome meat for human consumption. And yet there is always difficulty in drawing the line up to which pregnant animals may be slaughtered, and beyond which they must be condemned; or to which parturient animals must be condemned and beyond which they may be passed as fit for food.

A very large number of animals come to market with bruises and injuries which more or less affect the carcass. Last year for this cause we condemned, in round numbers, carcasses or parts of carcasses of 4,500 cattle, 1,000 sheep, and 12,300 hogs. In some of these the carcasses were only slightly bruised, in others the injuries were extensive, and in some cases complicated with abscesses, septic infection, and gangrene. These are serious conditions, which require careful consideration on the part of the inspector in order to determine when a part of a carcass only need be destroyed, or when it is necessary for the protection of the consumer that the whole carcass should be condemned.

There are certain animal parasites encountered which are capable of infesting man and which may cause slight illness or serious disease. We sometimes find the *Cysticercus bovis*, or larval stage of the *Tænia saginata*—not a very dangerous parasite, but one which most people would prefer to avoid. More dangerous than this is the *Cysticercus cellulosæ*, which gives rise to the *Tænia solium* of man. As there are conditions under which the larval stage of this tapeworm may develop in the human subject, causing serious disorders of important organs or even death, it is essential that the parasite should be recognized and infested meat destroyed. The most dangerous of this class of parasites, and one which is apparently becoming more common in this country, is the Echinococcus, the cause of the hydatid disease. The bladder worm may be found in almost any part of the body of the meat-producing animals, and especially in the lungs and liver of cattle, sheep, and hogs. Last year it was found in 204 cattle, 46 sheep, and 487 hogs, a total of 737 affected animals. The adult tapeworm, as you know, lives in the dog, and this animal scatters the eggs broadcast to infest other animals. The parasite is not directly transmissible from these animals to man, but the life cycle is completed by dogs eating the affected organs of the meat-producing animals. Man becomes affected from the eggs of the mature worm excreted by the dog. Hence the importance of meat inspection to discover the Echinococcus in animals and to secure their destruction before they can be devoured by dogs. In Iceland and some parts of Germany statistics show from 2 to 2½ per cent of the people affected with the Echinococcus disease.

The *Trichina spiralis* is in this country a common parasite of hogs. As the hogs run in the large packing centers, about 2 per cent are found affected, but in some sections of the country and at some seasons the proportion may be much less. On the other hand, special lots of hogs may be infested in a much greater proportion. Dangerous as is this parasite, it appears next to impossible to protect the consumer by inspection. A microscopic examination reveals most of the cases, but some will escape the closest scrutiny. It appears better, therefore, to rely upon cooking to make hog flesh safe, rather than to trust in microscopic inspection, which at the best lessens without entirely removing the danger.

There are, of course, inflammations of all organs and various infectious diseases of animals encountered which are accompanied by fever, emaciation, and organic changes which affect the quality and wholesomeness of the flesh. Among these diseases deserving of notice are the scabies of sheep and Texas fever of cattle. Both of these diseases are under control, but cases are still occasionally found at the slaughterhouses. The most common of all diseases are hog cholera and swine plague. Not less than 32,859 carcasses were condemned last year because affected with these diseases. Actinomycosis is a disease which is also quite frequently seen, since 2,427 carcasses of beef were condemned in whole or in part last year on account of it.

What is the effect upon the human consumer of eating the flesh of animals affected with an ordinary inflammation, say pneumonia or pleurisy? Or, going further, what is the effect of eating the flesh of animals suffering from infectious diseases not transmissible to man? It appears to me that our knowledge is somewhat deficient in regard to this, but certainly the habits and views of our people, coupled with the known danger from toxins liable to be developed in such diseases, and the more rapid decomposition of the flesh of diseased animals, which generally occurs, should be sufficient to justify condemnation. In general, the more pronounced the lesions found in the carcass, the more certain the inspector may be of his diagnosis and of the necessity of withdrawing the flesh from the open market. It is hardly necessary to explain to physicians that, where there are over 30,000 carcasses condemned for diseases such as hog cholera and swine plague, there will be many carcasses found in which the lesions are not clear, and where there is reason to doubt if they are due to these diseases.

It is with such equivocal cases that the conscientious inspector finds his greatest difficulty and embarrassment; for, on the one side, it is his duty to protect the public health, and, on the other, it is no less his duty to avoid the needless destruction of property.

The most common diseases found among cattle are tuberculosis and actinomycosis; and, with the exception of hog cholera and swine plague, tuberculosis is the most common disease found in hogs. With neither tuberculosis nor actinomycosis is it practicable or desirable to condemn to utter destruction the entire carcass of every affected animal. Both diseases in the early stages are usually localized and circumscribed, and without any effect upon the body as a whole. The lesion may be but a tenth of an inch, a fourth of an inch, or a half an inch in diameter. In such a case it would be an unjustifiable waste of the general food supply and an unwarrantable destruction of property to destroy the whole carcass, though the affected organ should be in every case condemned.

In Germany the whole of a tuberculous carcass is condemned only when there is great emaciation, or when a number of organs are affected and the location of the lesions indicates that the infection has been carried through the blood stream. With us we condemn the carcass, not only when there is emaciation or a generalization of the lesions, but also when the lesions in any organ or organs are of such number and size as to indicate that the system at large may have been affected, either by the inflammation, by the mixed infection, by the secretion and absorption of pus or toxic principles, or by interference with the general nutrition of the body.

With hogs it is necessary to be even more particular than with cattle, because the disease is of a more acute type and there is a much greater tendency to generalization of the lesions. The increasing prevalence of this disease among hogs is most disquieting to the sanitarian, and deserves the early and serious consideration of all who are interested in limiting the ravages of this disease.

Turning now to the question of milk from diseased animals, I doubt if anyone who has not been actually engaged in the inspection of dairy stables can quite appreciate the condition in which the cows of some of these are liable to be found. Inflammation of the udder is a very common affection, and may subside after a few days or may terminate in an abscess. Very often there is catarrh of the milk ducts or an abscess opening into these channels, and in either case the secretion passes away with the milk.

In other cases there may be infective inflammations of the udder or tuberculosis of the organ, when, of course, the condition is even more serious. The extent to which tuberculosis may develop in the cow's udder and the tremendous quantity of thin tubercular material which may be mixed with the milk in such cases was demonstrated by the specimens which I exhibited at the meeting of this association at Atlantic City last summer.

Tubercle bacilli may be present in the milk of tubercular cows, however, when there are no signs of tuberculosis of the udder. The investigation of this subject has been greatly aided by the tuberculin test, which directs our attention to the affected animals. It has been proved that in some countries from 40 to 50 per cent of all the cows have tuberculosis. In the United States the proportion is very much less, being probably not over 5 per cent in our worst affected States. Yet there are many herds here as badly affected as the worst herds of Europe. It is not uncommon to find 85 to 95 per cent of reacting animals in a large dairy herd. The proportion of these which give infected milk depends upon the extent to which the disease has progressed in the animals. Some investigators have found infection in the milk of only those cows which have tubercular lesions in the udder—say in 1 or 2 per cent of reacting cows. Others equally competent have found infection in the milk of 12, 15, 33, and even 66 per cent of the reacting cows which were investigated.

I have not the time, even if I had the data and were so disposed, to point out the effect upon the human consumer of taking into his digestive canal the meat and milk of diseased animals. This paper is designed to be suggestive. Its aim is to call attention to conditions of more or less seriousness which are constantly found in a certain proportion of the animals shipped to market for human food. Since the Federal inspection has been established for meat shipped in the interstate trade the tendency is to send the known diseased animals to the slaughterhouses which kill for the local trade, and have little, if any, inspection.

Unquestionably the products of many badly diseased animals get upon the market and are eaten. What effect does this have upon the public health? What proportion of the cases of diarrhea, cholera morbus, etc., are due to such food? What is the extent of the danger from taking large quantities of tubercle bacilli in either rare meat or in uncooked milk? These are dietetic questions which, it appears to me, might well receive more attention. Without doubt there should be greater efforts than have yet been put forth in this country to secure a pure and wholesome food supply. Those who are working in this direction need the encouragement and aid of the general practitioner of medicine—I might say of the whole medical profession. They need even more than this—the experience and knowledge which are gained by the men in the active practice of medicine. Would it not be well to have more cooperation and a more frequent exchange of views?

TUBERCULOSIS OF ANIMALS IN SOME OF ITS RELATIONS TO HUMAN TUBERCULOSIS.[a]

By D. E. Salmon, D. V. M.,
Chief of Bureau of Animal Industry.

It is not necessary to consume time in demonstrating the importance of a thorough consideration, from every point of view, of the subject of tuberculosis. The importance of such a study is now generally recognized. As smallpox was the great medical problem at the close of the eighteenth century, so tuberculosis was the most urgent problem at the end of the nineteenth century. According to Newsholme, smallpox reached its highest point in England in 1796, when 18½ deaths out of every 100 deaths were caused by that disease.[b] Tuberculosis was apparently at its maximum in England and Wales in 1838, when 17 deaths out of every 100 deaths were caused by phthisis;[c] and, if the deaths from other forms of tuberculosis could be added, the maximum smallpox death rate of 1796 would be surpassed. The death rate from tuberculosis, and particularly from phthisis, has been greatly decreased in England and Wales since the date mentioned, but in 1896 the deaths from all forms of tuberculosis still equalled 10½ out of every 100 deaths.

At the beginning of the twentieth century we find the mortality from smallpox insignificant compared with what it was at the beginning of the nineteenth century. In England and Wales in 1896 it was as low as 1.8 per million; that is, there were only as many deaths from smallpox in 1896 among 200,000 people as there were among 1,000 people in 1796. In other words, there was but 1 death in 1896 from smallpox where there were 200 in 1796.

I have dwelt upon these facts with some detail because this tremendous reduction of the death rate from one of the most serious diseases of mankind was accomplished by a study of one of the diseases of animals and the application of the knowledge thus obtained to human sanitation. This great advance in medical science and in the ability to prevent disease demonstrates the practical value of a knowledge of comparative pathology, and of a sincere effort to apply this knowledge in the formulation of measures for the control of the diseases of man.

Taking up the problem of tuberculosis, we find that the disease is caused by a bacillus so exacting in its conditions of growth that it can hardly be expected, in its virulent form, to multiply elsewhere than in the animal body or under the artificial environment supplied by the laboratory. The source of virulent tubercle bacilli is, therefore, either a person affected with tuberculosis or one of the lower animals affected with that disease. When we consider the facts which have been demonstrated by the studies of comparative pathology, we can not but be impressed by the conclusion that there is a great culture ground and reservoir for tubercle bacilli outside of the human body, and existing principally in the bodies of the domesticated animals which supply some of the principal articles of human food. This well-known condition of affairs seems to be a sufficient justification for a review of our knowledge of animal tuberculosis and the relation which it bears to the human form of the disease.

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[a] Read at the meeting of the American Medical Association, held at Minneapolis, Minn., June 4-7, 1901.

[b] Vital Statistics, 3d ed., p. 211.

[c] Dr. Ransome, Lancet, July 11, 1896.

We must go abroad for most of the statistics of tuberculosis in animals, and, while it is more frequent in European countries than here, we can learn from them as to the conditions which are likely to develop here as the animal population becomes more dense and providing the spread of the infection remains practically unrestricted. The slaughterhouse statistics of Prussia show 14.6 per cent of the cattle and 2.14 per cent of the swine to be tuberculous; in Saxony the percentage is 29.13 with cattle and 3.10 with swine; in the city of Leipzig the figures are 36.4 per cent with cattle and 2.17 per cent with swine (Siedamgrötzky). Of 20,850 animals in Belgium tested with tuberculin in 1896, 48.88 per cent reacted (Stubbe). Of 25,439 tested in Denmark from 1893 to 1895, 49.3 per cent reacted, and of 67,263 tested from 1896 to 1898, 32.8 per cent reacted (Bang).

The British "Royal commission appointed to inquire into the effect of food derived from tuberculous animals on human health," which reported in 1895, after giving the statistics of the Copenhagen slaughterhouses, where 17.7 per cent of the oxen and cows were found tuberculous, and of the Berlin slaughterhouses, where 15.1 per cent of such animals were tuberculous, continued as follows:

> There do not exist for the United Kingdom any records with which these can be compared. At Copenhagen and Berlin all the meat furnished to the towns is submitted to the inspection of experts. But we have reason to think that the facts about tuberculous animals would exhibit a broad resemblance to the foregoing, if such records could be obtained; not more different in degree, that is, than the difference between the Copenhagen and Berlin records, or than would be explained by variations in the practice of dealing with food animals in one and another country. Such few data as are to be had for the United Kingdom confirm this view.[a]

An examination of 20,930 cattle in Great Britain, either slaughtered and examined postmortem or tested with tuberculin, showed 5,441, or 26 per cent, affected with tuberculosis.

It is said that breeding cattle from Great Britain carried tuberculosis to Denmark in the first half of the nineteenth century, and that it is now being carried in the same manner to Sweden and Norway (Bang). British cattle are also accused of carrying the disease to

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[a] Report I, p. 11.

Argentina and spreading it among the cattle of that country (Sivori). There has also been discovered a large percentage of tuberculosis among the cattle of Victoria, in Australia, where it was probably introduced in the same manner. Some of the largest breeding herds of Canada, also of British origin, have been found badly diseased, and 20 per cent of the cattle offered for importation into the United States from Canada were found tuberculous.

In the United States our statistics are fragmentary, but sufficient to show that while the disease does not affect as large a proportion of our cattle as have been found affected in European countries, it is nevertheless widely distributed, and in some sections has progressed to a serious degree.

From a recent review[a] by Drs. Russell and Hastings, of the Wisconsin Agricultural Experiment Station, of the tests of cattle for tuberculosis which have been made in the United States, the following summary is presented:

State.	Number tested.	Number tubercular.	Per cent tubercular.
Vermont	60,000	2,390	3.9
Massachusetts	24,685	12,443	50.0
Massachusetts, entire herds	4,093	1,080	26.4
Connecticut	6,300	....	14.2
New York, 1894	947	66	6.9
New York, 1897-98	1,200	163	18.4
Pennsylvania	34,000	4,800	14.1
New Jersey	2,500	....	21.4
Illinois, 1897-98	929	....	12.0
Illinois, 1899	3,655	560	15.32
Michigan	....	....	13.0
Minnesota	3,430	....	11.1
Iowa	873	122	18.8
Wisconsin:			
Experiment station tests—			
Suspected herds	323	115	35.6
Nonsuspected herds	935	84	9.0
State veterinarian's tests—			
Suspected herds	588	191	32.5
Tests of local veterinarians under State veterinarian on cattle intended for shipment to States requiring tuberculin certificate	3,421	76	2.2

The State veterinarian of Pennsylvania, Dr. Pearson, thinks that not over 2 per cent of the cattle of that State are tubercular; and probably if a general test of all the cattle of the other States mentioned were made we should find a very much smaller proportion tuberculous than is indicated by this tabular statement. The explanation of the high percentages that have been given is found in the fact that it has been, for the most part, suspected herds which have been tested. Admitting that the greater part of these percentages are too high, we still have revealed a condition which is worthy of our serious consideration.

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[a] Bulletin No. 84, Wisconsin Agricultural Experiment Station, March, 1901.

The classes of cattle most affected are breeding animals and dairy stock. The beef cattle coming to our markets are still singularly free from tuberculosis. Of 4,841,186 cattle slaughtered in the year 1900 under Federal inspection, but 5,279, or 0.11 per cent, were sufficiently affected to cause condemnation of any part of the carcass. Of 23,336,884 hogs similarly inspected, 5,440 were sufficiently affected to cause condemnation of some part of the carcass. This is equal to 0.023 per cent, or slightly more than one-fifth, the proportion found in beef cattle. It is scarcely necessary to add that there are certain lots of cattle and hogs encountered which are affected in much greater proportion than the general average just given.

With hogs, tuberculosis is a disease generally contracted from the ingestion of infected food, and hence, as the disease is allowed to spread among cattle, it will become more frequent with the hogs that eat the skim milk, buttermilk, and other waste products of the dairies. In these animals the disease is more acute, and has a much greater tendency to generalization than with cattle, and consequently there is more danger of the meat becoming infected.

Tuberculosis is not preeminently a disease of poor, neglected, underfed scrub cattle, for the better class of cattle have suffered perhaps to a greater degree. Being constantly imported with purebred stock, it has been introduced into the best herds, and has extended from them to the dairy herds and common cattle. It was said in an official investigation of one of the most noted Canadian herds that wherever animals from that herd had been taken to improve the native stock there tuberculosis was found among the farmers' cattle.

A brief list of infected herds which have been carefully studied may be useful in showing the extent to which the disease develops and the difficulty of building up a herd of good cattle under the best conditions and keeping it free from this disease:

Herd of—	Number in herd.	Number tuberculous.	Per cent tuberculous.
Soldiers' Home, Washington, D. C	63	53	84
Massachusetts Agricultural College[a]	32	25	78
New Jersey Agricultural Experiment Station	42	25	60
Vermont Agricultural Experiment Station	33	21	64
Ohio Agricultural Experiment Station	30	14	46
Texas Agricultural Experiment Station	21	10	48
Wisconsin Agricultural Experiment Station	30	26	86
Kansas Agricultural College[b]	56	15	27
Government Hospital for the Insane, Washington, D. C.[c]	102	79	77
Maine Agricultural Experiment Station[d]	....	....	....

[a] This test was made in 1894; 18 animals had previously been killed in 1891-92 and 9 in 1893 to check the progress of the disease.

[b] At the time of the test two animals had been isolated, one for chronic nasal discharge and one for indurated udder. Aside from these two there was no reason to suspect but that the herd was in good condition and as free from disease as the average.

[c] Thirteen of the animals in this herd had recently been purchased and were all free from the disease. Excluding these, 90 per cent of the herd was tuberculous.

[d] *So badly diseased* that entire herd was slaughtered in 1886.

There is little doubt but that tuberculosis in cattle and hogs has been increasing in this country as well as in most other countries during recent years. This is shown by slaughterhouse statistics and official inquiries. There appears to be no climate and no method of handling cattle which entirely arrests the spread of the disease. In Argentina it is held that the native cattle were free from it until it was introduced by the British breeds of beef cattle, and that it has spread among the native animals in proportion to the improved breeding stock which has been used (Sivori). In Australia and New Zealand the slaughterhouse statistics, according to official reports, show as high as 3½ to 4½ per cent of the adult cattle tuberculous. Considering that in these countries the cattle live in the open air, and that the climate of Australia has been considered a remarkably favorable one for tuberculous people, we can not avoid the conclusion that our beef cattle, even on the Western plains, are liable to have the disease propagated among them by the use of tuberculous breeding stock. At present the statistics of Buenos Ayres show almost three times the percentage of tuberculosis which is found in the average of our Federal meat inspection, while in Australia and New Zealand thirty to forty times our percentage has been reported.

These facts indicate the insidious and constant progress of this fatal disease among meat-producing animals in the most varied climates and under all conditions. The tuberculin tests made in Minnesota, Iowa, Nebraska, Kansas, and California, and information received from Montana, Utah, and some other States of the Rocky Mountain region, indicate that we have no climate in the United States so favorable that it may be relied upon to save our cattle from tuberculosis if the contagion is introduced among them.

The importance of maintaining the source of our food supply free from the contamination of any disease is no doubt appreciated by every physician; but when the disease which threatens it is communicable, fatal to man, and surpasses all other diseases in the mortality which it causes in the human race, are we likely to exaggerate its seriousness or to urge with too great insistence its effectual control?

This brings us to the question of the transmission of tuberculosis from animals to man, and here we find the most divergent opinions even among those who have given considerable attention to the subject. In the most superficial examination of the question we must be impressed with the fact that in the domesticated animals we have a great breeding ground and reservoir for the bacilli of tuberculosis which is at this time practically beyond the reach of the physician and health officer. Is this accumulation of tubercle bacilli dangerous to man when he works in the germ-laden air of the infected buildings, caring for the cattle, milking the cows, and cleaning the stables, or, above all, when he handles the infected products and takes them into his stomach as food?

It has been pointed out by investigators that there are slight differences in the morphological and physiological characters of the human and bovine tubercle bacillus, that the bovine bacillus is more virulent for experimental animals, and that the human bacillus is inoculated with difficulty upon cattle, and usually produces a circumscribed and mild disease. From this there has been a tendency to conclude that human and bovine tuberculosis were distinct diseases, and that animal tuberculosis might be neglected as a source of the human disease. This reasoning, it appears to me, is most unsafe and illogical.

There is probably no pathogenic microbe which undergoes greater modifications in the laboratory under various conditions of environment than the tubercle bacillus, and this is illustrated by the difficulty with which the first cultures from the diseased subject are obtained, and the ease with which it is grown upon a variety of media after it has been gradually accustomed to the changed conditions of existence. If it so readily varies its requirements in the laboratory, is it not reasonable to suppose that it may, in an equally short period, be modified to as great or to a greater extent in the bodies of different animals? And, if the bovine bacillus is more virulent for cattle, sheep, goats, hogs, guinea pigs, and rabbits than is the human bacillus, may it not also be more virulent for man?

The frequent exposure of man to the bovine bacillus is demonstrated beyond doubt. That the air of infected cow stables is a bearer of the bacillus is abundantly proved by the spread of the disease among the cattle in such stables, since postmortem examination proves the majority of infections among cows are through the respiratory organs. The muscular tissues of animals probably do not contain the bacilli in sufficient numbers to be infective except in the case of generalized tuberculosis. The cases of generalized tuberculosis are not rare. In Germany, out of 482,501 tuberculous cattle, 12,017, or 2.8 per cent, were condemned for generalized tuberculosis (Siedamgrotzky); and Nocard states that of 43,000 cases 10.7 were generalized. In addition to the distribution of the bacilli through the blood in generalized tuberculosis, it has been shown that there is considerable danger of the flesh of other advanced cases being infected by contact with the diseased organs and by smearing with tuberculous material from the knives of the butchers.[a]

The infectiousness of milk from tuberculous cows has been frequently proved by microscopical examination, by inoculation, and by feeding experiments. The one point about which there has been some difference of opinion is as to whether a cow with a clinically healthy udder can give infectious milk. It is generally admitted from slaughterhouse statistics that from 1 to 2 per cent of tuberculous cows have tubercular deposits in the udder. These statistics are not absolutely accurate, because the examinations are not usually made with that thoroughness which is required to discover all of the minute lesions, and also because in many cases, while the number of tuberculous udders is given, the total number of tuberculous animals includes calves and sometimes bulls and steers. The percentage of cases in which the udder is affected must therefore actually be greater than the figures just given.

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[a] Report Royal Commission Great Britain, 1895, p. 14.

If we could be certain that not more than one or two animals among 100 tuberculous cows would give infectious milk, that fact would be somewhat reassuring; although, as Virchow said in his address before the International Tuberculosis Congress of Berlin in 1899, the tubercular lesions may directly involve the milk ducts, in which case thousands of bacilli may be carried in the milk, and a single cow in such condition may be sufficient to infect the people of a whole village or even more.[a]

Careful researches of competent investigators indicate, however, that a much larger proportion of tuberculous cows yield infectious milk than is admitted to have diseased udders. Bollinger, Stein, Bang, Hirschberger, Ernst, Smith and Schroeder, Robinowitsch and Kempner, Ravenel, Gehrmann, and Nörgaard have all found the milk infectious when no lesions could be discovered in the udder. These investigations cover a considerable number of cows, and, as infectious milk was obtained in from 6.5 per cent to 66.6 per cent of the animals, they prove either that the udder is affected in a much larger proportion of cases than has been admitted, or that many cows with sound udders excrete tubercle bacilli in the milk.

It is not probable that so many investigators would overlook tuberculosis of the udder if it existed, and reach a faulty conclusion; but if we admit that this did occur, we must also admit that such an error is much more likely to happen in the ordinary slaughterhouse examinations, and that consequently the frequency of tuberculosis of the mammary glands should be placed at 10, 15, or 20 per cent of the diseased animals instead of 1 or 2 per cent, as at present. Dismissing the question as to whether the udder was affected in all of these cases, the practical conclusion of the sanitarian is not changed, and that is that the milk is infectious with a large proportion of tuberculous cows, and that with many of these no disease of the udder can be found in the living animal.

The milk of such animals produces tuberculosis in guinea pigs, hogs, and calves when fed to them. Will it have the same effect when taken into the digestive apparatus of man? In other words, is bovine tuberculosis communicable to man? There are many cases on record indicating this communicability, but I have space to refer briefly to but a very few.

Two veterinarians of Pennsylvania have been reported to me as infected by making postmortem examinations on tuberculous cows.

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[a] Report, p. 349.

In both, local tuberculosis developed and the tubercle bacilli were demonstrated in the excised tissue. In another similar case in the same State the character of the lesion was demonstrated by the inoculation of guinea pigs.[a] L. Pfeiffer cites the case of Veterinarian Moses, 34 years old, of healthy family, and personally in good health, who pricked his left thumb in making an autopsy on a tuberculous cow. The point of the knife probably penetrated into the articulation of the first and second phalanges. The puncture healed without suppuration, but at the end of six months there formed at the seat of the cicatrice a cutaneous tubercle, and the joint was removed. Soon afterwards the patient began to cough, and died of phthisis eighteen months after the accident. On opening the articulation of the thumb it was found filled with caseous masses extraordinarily rich in bacilli. A similar case in the United States was brought to my attention by Dr. M. P. Ravenel. The case occurred in the practice of Dr. M. B. Hartzell and was partially reported to this association in June, 1897. The patient, a man in excellent health and weighing 175 pounds, was employed by a railroad company to work upon cars used for the transportation of cattle. He was wounded upon the back of the hand by a piece of broken woodwork of a car, and typical verrucous tuberculosis developed locally. This was apparently successfully treated by Dr. Hartzell. Within a year the patient's general health changed greatly; he was emaciated, had a persistent and frequent cough with abundant expectoration, and there was decided dullness at the left apex with numerous râles. Death soon resulted from general tuberculosis. A very interesting case of "primary subcutaneous tuberculosis," caused by the topical application of cream, was reported in the Omaha Clinic, February, 1896, by Dr. A. Grothan. The family was using the milk of one cow only, and inoculations of two rabbits with milk and cream from this cow caused tuberculosis in each.

These are very clear cases and sufficient to demonstrate the communicability of bovine tuberculosis to man, and they indicate that bacilli from a bovine source are at least as virulent for man as are bacilli froma human subject.

Now, we are asked, if bovine tuberculosis is dangerous to man, and is increasing, how is it that consumption, or phthisis, is decreasing? It appears to me quite conceivable that the conditions of life, and above all of sanitation, may be so improved that their influence will more than counteract the increasing danger from the extension of bovine tuberculosis. But quite aside from this, it must be admitted that phthisis, or tuberculosis of the lungs, is usually contracted by inhaling the infection, while if the disease is communicated through the food it would probably take some other form (tabes mesenterica, tubercular meningitis, etc.). It is clear, then, that in estimating the effect of increasing bovine tuberculosis we must make a distinction between phthisis and other forms of tubercular disease.

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[a] Ravenel, Phila. Med. Jour., July 21, 1900.

Sir Richard Thorne-Thorne in the Harben Lectures for 1898 has made this very clear. He shows from the statistics of England and Wales that between the periods 1851–1860 and 1891–1895 there has been a reduction of the mortality at all ages from phthisis of 45.4 per cent; while from all forms of tuberculosis the reduction has been distinctly less, namely, 39.1 per cent. Taking that form of disease registered under the name of "tabes mesenterica," the reduction at all ages has been but 8.5 per cent; under 5 years of age the reduction has been but 3 per cent; while under 1 year of age there has been an actual increase of 27.7 per cent. This is the milk-drinking age, and the increase of the mortality is very significant at a time when phthisis has been so remarkably reduced. Making all proper allowances for errors in diagnosis among the returns for tabes mesenterica, it is still apparent that there are altogether different influences at work in the causation of this disease from what are usual with phthisis.

The conclusions which naturally follow from these statistics are so different from what has been generally held that numerous attempts have been made to counteract them. Dr. George F. Still recorded "Observations on the morbid anatomy of tuberculosis in childhood,"[a] in which he gave a résumé of the results of 769 consecutive autopsies on children. Of these, 269 presented lesions of tuberculosis, but death was due in 43 of these to some other cause. The channels of infection in the 269 cases were as follows: Lung 105, intestine 53, ear 9, bones or joints 5, while the remainder were more or less uncertain; that is, the intestinal infections were to the others as 1 to 2.1. With the class of cases where death was caused by some other disease and where the tuberculosis was either arrested in an early stage or had not progressed beyond the initial stage, affording almost indisputable evidence of the method of infection, the infections were by the lung 26, by the intestine 16, by the ear 1. Here the intestinal infections were to the others as 1 to 1.7. In the English statistics the cases of tabes mesenterica in children 5 years and under are to the other forms of tuberculosis as 1 to 1.6. Dr. Still's observations are, therefore, a singular indorsement of the accuracy of the returns under the name of tabes mesenterica, and, as the ages of the children covered by his autopsies were 12 years and under, he has really found a larger percentage of intestinal infection than is indicated by the statistics.

Dr. J. Walter Carr also referred to statistics of necropsies on tuberculous children at the Victoria Hospital.[b] He found 79 in which the disease most probably started in the chest and 20 in which it seemed to have begun in the abdomen. Here the relation between the two forms of infection is as 1 to 4. In 26 children of early or limited tuberculosis the thorax was alone affected in 12 cases and the abdomen in 7, being in the proportion of 1 to 1.7. Of 53 tuberculous children under 2 years of age the disease most probably began in the chest in 43 and in only 5 certainly in the abdomen, the proportion in this case being as 1 to 8.4. Of 27 children over 5 years of age the disease began in the chest in 12 and in the abdomen in 6, the relation being as 1 to 2.

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[a] Brit. Med. Jour., Aug. 19, 1899, p. 455.

[b] Brit. Med. Jour., Sept. 2, 1899, p. 626.

These statistics, being all from English sources, are fairly comparable, and it appears to me they sustain Dr. Thorne's contention that the returns in England of tabes mesenterica represent with fair accuracy the abdominal tuberculosis of children.

Bollinger, in his address at the International Tuberculosis Congress of Berlin, in 1899, quoted with approval the record of autopsies by Heller (Kiel) of 248 tuberculous children, which showed in 45.5 per cent of the cases tuberculosis of the mesenteric glands. From these it was concluded that milk played a leading rôle in the so-called transmitted tuberculosis of children.

It is plain from what has been said, without quoting further statistics, that in some countries where bovine tuberculosis is very frequent there is also great frequency of tuberculosis in children. Bollinger concludes that "although the tuberculosis of cattle and swine do not stand in the first line as source and starting point of human tuberculosis, nevertheless—considering their enormous distribution and progressive additions and the great danger from the ingestion of the milk of tuberculous cows—they are certainly for humanity the most important and most dangerous of all animal plagues, and deserve the most earnest attention from the sanitarian and the State."

Admitting the subordinate rôle played by digestive infection in human tuberculosis, admitting that in England there is but one such case to nine cases of all forms of tuberculosis, still the matter is one deserving the most careful consideration of the sanitarian. But the harm does not stop with the cases directly infected by food, since these may in turn cause secondary infections, and thus give rise to a series of unlimited extent.

It is not my purpose to exaggerate in the least the danger from animal tuberculosis, but there has unfortunately been a tendency in recent years to make light of this danger. Let us take facts as our guide, and not be unduly influenced by personal opinions. If it can be shown, as I believe it has been, that animal tuberculosis may be communicated to man, then the presence of vast numbers of tuberculous animals in a country must be looked upon as a source of danger and one which it is our duty, as sanitarians and as citizens, to do our utmost to abolish.

THE CATTLE INDUSTRY OF THE UNITED STATES.[a]

By JAMES WILSON,
Secretary of Agriculture.

The condition of the cattle industry in the United States at this time is a subject for congratulation. There is a demand for all classes of cattle at prices far above those which have ruled in recent years. Beef cattle, dairy cattle, and purebred cattle all may be marketed on terms favorable to the breeder and feeder.

When we consider the depression and discouragement which existed in this industry but a few years ago, we can only marvel at the change which has been brought about in so short a time. And this change has occurred, not as the result of disasters to the industry, not as the result of losses or sacrifices of animals, but in spite of the fact that we have maintained a stock of cattle unexampled in the history of the country for numbers and values.

The preliminary census figures which have been made public are surprising. They show a much larger number of cattle than many writers anticipated. They demonstrate that during the years of the last decade, when it was supposed the stock of cattle was being depleted, it was really increasing. And now it would appear that we actually have more cattle, and also more in proportion to population, than we have ever had before.

The same number of breeding cattle gives us a much greater annual product of beef now than it did fifty years ago. The stock of cattle has been improved; it is more precocious; bullocks are marketed at an earlier age; and the carcasses average heavier and better. With dairy stock there has been a similar improvement. The animals are more precocious, the average yield is better, and the average product has greatly improved.

All of this, of course, is to the advantage of the producer. It means that his breeding cattle are worth more money, that his sales bring him greater returns, and that his profits are correspondingly larger.

These are the facts as we see them at this time. How can we explain the high price of cattle at a time when the numbers and products are greater than ever before? It can not be accounted for by any variation in the crops of the country as a whole, or of any part of it; neither can it be explained by any variation in the amount of exports of cattle or cattle products. It is due principally to changed conditions in the United States; to the great and universal prosperity which prevails; to the increase in manufactures; and to the existence of a vast army of workingmen who are able to purchase and pay for the best beef and butter and cheese. We are manufacturing the iron and steel, the machinery, the textiles, and other finished products for the world, and are feeding, directly and without any restrictions, the laborers who are necessary to keep these enormous manufacturing enterprises in operation.

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[a] Read before the Central Shorthorn Breeders' Association, Kansas City, February 4, 1902.

The statistics indicate that it is preeminently the development of the home market which has benefited the cattle industry.

For many years our breeders have been working incessantly, with American energy and American intelligence, to establish in the United States the highest types of the best breeds of cattle. They have spent their money with a lavish hand for breeding stock; they have had the advantage of the most fertile soil in the world, and of a temperate climate favorable to animal life of all kinds. The cattle which they have produced have during late years held their own in the show rings with the best imported. It has seemed to me that we have reached a point where we might reasonably claim that we have as good cattle as exist in any country, and that we might assert our independence of foreign breeding stock.

Firmly believing that the development and high character of our purebred cattle warranted such assertions, I have taken steps to bring our animals to the attention of the countries south of us, who are just reaching that stage of progress in animal husbandry where large numbers of such cattle are needed to grade up the native stock. I have had in mind particularly Mexico and Argentina as countries which must soon, of necessity, bring their cattle to the modern standard. But the people of those countries know good cattle when they see them and they want the best. It is useless to try to sell our culls in those markets. The first shipment of inferior stock will damage our prospects or perhaps ruin all chances of building up a trade. What is required is, first, confidence in our own stock, and, secondly, the determination that when the opportunity for shipment comes only the best cattle shall be permitted to go to represent us in these foreign markets.

There is still a sentiment among some cattlemen in this country that we must have fresh blood from Europe to maintain the standard of our herds. This sentiment has been handed down by tradition from the early days when we began building up our herds; when many of the cattle imported were not as good as they should have been, and when our breeders were not as skillful as they are to-day. It has been kept prominent by the importers and dealers in imported stock, and by people who profited by such transactions otherwise than by the improvement of their cattle. I believe I am right in concluding that this sentiment has no other foundation than tradition and personal interest at the present day, and I am going ahead upon that theory and trying to put our cattle into the markets of the world. But suppose, for the sake of argument, we accept the other view; would we not be asked at once by our prospective customers why they should not go to the same source that we are obliged to draw from? If our herds are not as good as the British herds, if they have not the quality of permanency, what arguments can we use to induce people who want the very best to come to this country for our cattle? Should an American breeder find that a remarkably good animal had been produced abroad, having strains of blood corresponding with his line of breeding, I should expect him to try to gain possession of that animal, just as I should expect an intelligent English or Scotch breeder to come to this country for an animal under the same circumstances, if he were not prevented by the rigid sanitary restrictions enforced by his country, and as they sometimes did before such restrictions were imposed. But the idea that foreign cattle as a class are better in the show ring, or have greater prepotency than our cattle, is a fallacy which the American breeder should set about dispelling now and for all time.

We have within the United States the most varied soils and the widest range possible of climatic conditions, within the limits favorable to the high development of the domesticated animals. No doubt there are some sections which are specially adapted to the highest types of certain breeds. Our breeders should study this question, and they should try to unite the conditions of soil, the conditions of climate, the methods of feeding and treatment which are best suited to each particular breed. In that manner we shall produce animals of all breeds equal to any in the world—animals which are the product of their environment, and which, consequently, become more and more capable of transmitting their characteristics to their offspring. It is not surprising that the highest types of animals bred in distant countries, under the peculiar conditions which exist there, should, in certain instances after being brought to this country, show some falling off in succeeding generations, as a result of the violent change in their environment. But this deterioration is not permanent, if they are properly managed; and when the herd recovers from the shock of being transplanted to a totally different climate, it is the more valuable on that account, for it is then acclimated, as we say, or, in other words, it has become adapted to the different conditions of life.

Now, as you know, the climate in the original home of the British breeds has marked peculiarities. The atmosphere of the island is laden with moisture, the summers are cool, the grasses grow rapidly and they contain a large proportion of water. It is quite different in most parts of the United States; but our conditions approach the conditions found in Mexico and South America. British breeds acclimated here may be taken from here to those countries with far less shock, with far less danger of deterioration and disease, than if taken directly from Great Britain. This is a point which should be understood by our own breeders, and which we should endeavor to impress upon the stockmen of other countries on the American continent.

Among the first questions, however, which we are asked by the governments of countries to which we propose to export animals are: Are they free from contagious diseases? and, Can you guarantee that they will not be exposed to the contagion of any such diseases on their way to the ships which are to carry them? This is to-day the most important question to all governments that are willing to consider the advisability of admitting foreign animals to their territory. Most of you know how, on account of pleuropneumonia in this country, we lost the freedom of the British market for our live cattle over twenty years ago. Since that time our cattle have been killed on the docks where landed within a prescribed number of days. You can readily see that when our animals are once landed without the privilege of shipping to any other market, without the ability to hold them beyond the ten-day limit, our shippers are at the mercy of the English buyers. How many millions of dollars those restrictions have cost the American farmer never will be known; all that we can say is that we have lost and are still losing an enormous amount of money because we permitted that disease to remain a few years too long upon American soil. We might just as well have stamped the disease out in 1870 as in 1890, and if we had done so, there would have been no occasion for these restrictions, which now have been permanently imposed. The reason we did not act sooner was that we listened to the counsels of a lot of noisy and insistent individuals who thought they knew all about the subject, but who really were densely ignorant of everything pertaining to it. They claimed there was no pleuropneumonia in the country; or, admitting that there was such a disease, they were certain there was no danger from it; or, if they were forced to admit the existence of some danger, they scouted the idea that the British would ever restrict the cattle trade on account of it.

We have had about the same experience in regard to sheep scab. It was scattered all over the country; the stockyards and markets were infected with it; all sheep in transit were exposed to it; and, notwithstanding inspection, it would break out among our export sheep under the most inconvenient and embarrassing conditions. As a result of this, the British Government applied the same restrictions to sheep as to cattle.

The same disease has been the means of shutting our sheep out of the markets of France and other European countries. Now we are getting sheep scab under control, and with a few more years of intelligent work shall be free from it.

Much surprise has been expressed in some quarters with reference to a suggestion recently made by me that it might be well for us to consider whether the time had not arrived for following the example of Great Britain and entirely shutting out foreign live stock from our territory. We still have representatives of that same class of men who could see no harm to come to us from nursing pleuropneumonia among our cattle twenty years ago, and who are equally positive to-day that no harm can come to us from any other disease. But it seems to me that with a stock of the finest animals in the world, with the largest number of animals that any country has ever accumulated, with a fabulous amount of wealth invested in these animals—an amount unexampled in the history of the world—it seems to me, I repeat, that we should take stringent measures to insure these animals and this wealth from the one danger to which they may be exposed.

It is said that my suggestion to exclude live stock includes all kinds of animals—cattle, sheep, hogs, and horses. Very well, if all kinds of animals are liable to bring destructive and disastrous plagues to our shores, why not exclude one kind as well as another? It is absurd to lock one door to a stable and leave another and equally convenient door open for thieves to enter.

If we follow the example of Great Britain, as suggested, we would not exclude horses; and yet there are many dangers connected with the horse trade. Glanders has been an ever-present menace and source of loss for many years. Horses may also, it is believed, carry the contagion of foot-and-mouth disease. It may not be known to you, and yet it is a fact, that the Bureau of Animal Industry has been struggling for several years with an imported venereal disease of horses which has got upon the ranges of the Northwest, and which has so far defied all efforts for its complete eradication. As a climax comes the news of surra among the horses in the Philippines. Surra is a disease long known in India, of which we have heard little in the past, but with which we may become only too well acquainted in the future. Surra is caused by a small animal parasite which lives in the blood, and when once it gets into the blood of a horse it stays there for months and perhaps for years. It would, therefore, be not at all impossible for a horse harboring this parasite to be brought from the Philippines, or from India, or from any of the other Oriental countries where the disease exists, either directly to the United States, or indirectly by way of any of the European countries. Possibly the disease was carried to China with the horses of the troops from India, there it may have been communicated to the horses of the American army, and by these transported to the Philippines. What we know is that most of the horses in certain parts of the Philippines are affected this year and the disease is exceedingly fatal.

The parasite of surra is supposed to be carried from horse to horse by certain species of flies. Just what kind of flies these are or whether they exist in the United States is not definitely known. They certainly exist in the Philippines, and if they are not already here they may be introduced at any time. Surra is to horses what rinderpest is to cattle—a disease which spreads rapidly and is fatal in nearly every case.

Then why should we not adopt measures to protect our horses as well as our cattle? Why should we continue to live in a fool's paradise, imagining ourselves safe, when we see these diseases existing in other countries, jumping from one country to another, and, with faster and more frequent communication between all parts of the world, ever getting nearer to us in point of time, and on that account more dangerous? We have seen foot-and-mouth disease jump from the Continent to England again and again within the past two years, notwithstanding the prohibition of cattle, sheep, and hogs; we have seen rinderpest jump to the African Continent and spread over it like a sheet of flame, devouring the cattle and damaging the sheep; we have seen surra jump to the Philippines. Shall these disasters to other countries bring no lesson to us?

There are other diseases new and strange to us existing in various lands which may or may not be capable of introduction into the United States. There is, for example, the horse sickness of South Africa—a most fatal and unmanageable disease; there is the Angora goat disease; there are various sheep and swine diseases, notably the erysipelas of Europe.

And, finally, there is tuberculosis, which is neither new nor strange to us. Tuberculosis is perhaps the worst of all animal diseases because, like pleuropneumonia, it is a very insidious disease, entering a herd and progressing in it until most of the animals are diseased before its presence is suspected. Like pleuropneumonia again, when once it has entered a herd it remains there during the existence of the herd, unless stringent measures are adopted for its eradication. But its possibilities of danger are far beyond those of pleuropneumonia, because it attacks all species of domesticated animals—horses, cattle, sheep, pigs, and dogs. Its greatest ravages are, as you know, with cattle and hogs. In some countries 40 to 50 per cent of the cattle and 3 to 4 per cent of the hogs are affected with it. In this country we have had far less than most other parts of the world, but the disease is increasing in most parts of the United States. This is shown by the Federal meat-inspection statistics, which since 1895 have covered over 30,000,000 head of cattle and 120,000,000 hogs. In 1895 the condemnation of cattle carcasses for tuberculosis equaled 407 per million; in 1901 they amounted to 1,285 per million, or three times as many. In 1895 the condemnation of hog carcasses for this disease equaled 29½ per million; in 1901 there were 352 per million, or nearly twelve times as many. The inspectors are acting under the same instructions now that they did in 1895; and, making all allowances for the improvement of the inspection and its extension to smaller slaughterhouses, where classes of animals are killed that are more likely to be affected, there is no escaping the conclusion that the disease has become much more frequent in slaughtered animals. What is the explanation of this fact?

In various countries the conclusion has been reached, after careful investigation, that tuberculosis was being spread by purebred animals purchased to improve the common animals of the country. Has that been the case with us? I know that this seems at first sight an ungracious suggestion to bring before an association devoted to the production of purebred stock, but I believe you have the strength, intelligence, and honesty to meet it squarely, and to take such measures as are necessary to guard against the dissemination of this disease by the cattle which you breed. When the Department of Agriculture began making tests of the purebred cattle coming into the United States from Canada, it found that 24 per cent of them were affected with tuberculosis; and in some of the tests made in Great Britain of cattle that importers desired to purchase, it was found that 50 per cent had the disease. How is it possible to maintain the health of our cattle if we continue to import that kind of breeding stock?

I present these facts plainly because you are the men who should, above all others, be interested in the welfare of the cattle industry; and because I desire you to know my reasons for establishing and continuing the tuberculin test of imported cattle. If anybody can give us a better and more certain test to determine which animals are affected, I assure you I should lose no time in adopting it.

And now a concluding word in relation to the South American market. When we turned our eyes toward Argentina as a promising market for our fine stock, we found the Government of that country on the point of issuing an order excluding animals from all countries in which foot-and-mouth disease existed, or where sufficient precautions had not been adopted to prevent its entrance. That order was actually issued last May to remain in force for six months, and on its expiration it was renewed for three months. The second order expires early next month. We did not suppose that this order would affect our cattle, as the American minister was authorized to certify that foot-and-mouth disease does not exist in the United States, and he was also instructed to explain the thorough system of quarantine which we apply to imported stock. The Argentine Government held, however, that they had excluded British stock because they believed it might bring this disease, and, as we admitted British stock, they were of the opinion that consistency required them to exclude our stock, notwithstanding the quarantines and other precautions which we have adopted.

A semiofficial representative of Argentina visited the International Live Stock Exhibition at Chicago last December on the invitation of the officers and returned with a very favorable impression of our country and of our live stock. I have also sent a special agent to South America to ascertain the condition of their markets, and to give us full information as to the methods by which animals may be shipped and sold there to the best advantage. He has also been instructed to confer with the officials of the various countries and to explain to them that this Government is ready to inspect animals that are to be exported, to make the required test, and to certify to their healthfulness. Considering the condition of international trade—that we have been buying an average of seven and one-half million dollars worth of agricultural products from Argentina while she has been buying less than $150,000 worth from us—it would appear that we may reasonably expect some plan to be devised by which our animals may enter that market.

If that is accomplished we must, on our part, see that they get the value of their money; that is, the stock which goes there must be first class and in a healthy condition. If we permit animals of inferior quality or those affected with tuberculosis to be shipped there, the returns will not pay expenses and we shall never establish a trade.

I thank the officers and members of the association for their kind invitation to attend this meeting, and for the further invitation to send a paper in case I could not be present in person. If it were not for the important business which demands my presence in Washington at this time, I should certainly have been with you. I am interested in your work. I admire the noble Shorthorn, and I hope you will maintain the breed in the position which it has occupied so long—unsurpassed among the beef breeds, unsurpassed as a general-purpose animal.

LAMB FEEDING IN COLORADO.

By Lowell Clarke, D. V. S.,
Inspector, Bureau of Animal Industry.

The feeding of lambs in Larimer County, Colo., for the Eastern market, which has grown into an important and profitable industry, originated in an accident. In November, 1888, Bennett Bros., of Fort Collins, purchased 2,500 Mexican lambs in southern Colorado which they intended to ship to their feeding pens at Paxton, Nebr., where, with cheap corn, the owners expected to fit them for the Chicago market. At Trinidad, Colo., the shipment ran into a furious snowstorm, which blocked the railroad and prevented the train from moving for a period of over two weeks. Without sufficient food and adequate shelter during this period the lambs became thin and weakened so that it was deemed unsafe to attempt to run them through to Nebraska. They were consequently brought to Fort Collins and placed on the ranch of Bennett Bros., near this city, and fed all the alfalfa their half-starved condition demanded. A little later a moderate quantity of corn was added to the ration, the quantity of corn being increased near the close of the feeding season to 1 pound per lamb per day. In April, 1889, the lambs were shipped by rail to Chicago, where they brought $6.40 per hundred pounds, the extreme top of the market, and buyers wanted more of them. The experiment netted a handsome profit. In the season of 1889 and 1890 their operation was extended and 3,500 Mexican lambs were fed with even better results. This, in brief, was the genesis of the lamb-feeding industry of Larimer County. The growth of the industry from this accidental beginning may be seen by the following statement, compiled from accurate yearly reports:

Number of lambs fed in—		Number of lambs fed in—	
1888–89	2,500	1895–96	128,000
1889–90	3,500	1896–97	193,000
1890–91	6,000	1997–98	197,000
1891–92	30,000	1898–99	225,000
1892–93	40,000	1899–1900	215,000
1893–94	60,000	1900–1901	351,225
1894–95	80,000	1901–1902	194,497

In the spring of 1899 a number of feeders met with losses. The number of lambs on feed was larger than usual, the winter long and severe, with feed high and markets less favorable. These combined causes made some of the feeders a little timid and more cautious, resulting in a reduction in the number on feed in the winter of 1900. The markets in the spring of 1900 were, however, more favorable, Colorado lambs selling for $7.55 per hundred pounds in Chicago during the latter part of the season, and feeders made money. The success attending the operation of this year induced many others who had previously kept out to engage in the business, resulting in a large increase in the number of lambs fattened in the winter of 1900 and 1901. Unfortunately, during the entire season of 1901 the markets were flat and prices low, the bulk of the shipments of lambs from this section selling at figures far below the cost to the feeders. Nearly all of the feeders lost money and many were driven out of business. This backset resulted in diminishing, by more than 40 per cent, the number of lambs placed in the feeding pens in the fall of 1901.

As it is with all other industries, lamb feeding is not always rose-colored. There will be failures now and then, and whether or not it is profitable is determined by the average of several operations. So far as Larimer County is concerned, it can be said with absolute truth that the average is favorable. Those who have made money in the business exceed by far the number who have lost.

The experience of the past twelve years has proved that it is the most profitable industry the farmers of this county ever engaged in, without an exception. It affords them an excellent home market for their surplus hay and coarse grains and furnishes them profitable employment during the winter months. Besides large cash dividends one year with another, it is the means of enriching and keeping up the fertility of their farms, from which they harvest larger and better crops.

To be sure, the man about to engage in lamb feeding has many things to consider if he would be successful. The cost of the lambs, of the hay and grain fed, of freight, of the expense of marketing, as well as judicious feeding, are all factors which have a bearing on the result. Like any other industry, it must be managed with business-like sagacity to insure success.

Among the things which have combined to make lamb feeding in Larimer County successful and profitable the following may be mentioned:

First. An abundance of cheaply grown alfalfa hay of the very best quality known for stock feeding. Experience has shown that alfalfa as a rough food for lambs gives better results than any other kind of hay. They thrive on it and gain faster in size and weight than even on the best redtop and timothy. It makes their flesh whiter and tenderer and gives to it a better flavor than any other rough food that has been tried. Because Fort Collins lambs are fattened on alfalfa and corn is why they have such a good reputation in the Eastern markets and why they almost universally command the extreme top of the market. Alfalfa yields here three and four crops a year and can be grown, harvested, and stacked for about $2 per ton.

Second. Colorado's constant sunshine is an important factor bearing on the success of lamb feeding. The lambs are kept in open pens, no covered sheds being required. They are fed and finished in the open air, and yet it is a rare thing for them to have wet fleeces or to have to stand in snow or mud. The beneficial effects of Colorado's short, bright, and dry winters on lamb feeding are not easily estimated.

Third. The proximity of Fort Collins to the great sheep ranges of Wyoming, southern Colorado, Utah, and New Mexico, whence the supply of lambs is obtained, is an advantage not enjoyed by Eastern feeders at the same expense.

Fourth. The liberal treatment accorded by the railroads. The feeder can buy his lambs in New Mexico, bill and pay the freight on them to the Missouri River, ship them to his feeding pens here, where he is permitted to hold them until they are fitted for market, and then reload and send them forward under the same billing, being asked only to pay freight on the increase in weight. That is called feeding in transit. The lambs are held in the feeding pens from four to six months, according to circumstances, and fed all the alfalfa they will eat during the season, to which is added, at the beginning, a small portion of ground oats, wheat, or barley. Some feeders begin with a mixture of ground oats, wheat, and barley, which they keep up from a month to six weeks, and then change to corn. This ration is fed to promote growth of bone and muscle. At first the corn ration is small—from one-fourth to one-half pound to each lamb per day. This is gradually increased as the season advances to 1 pound or more per day. Very few lambs will consume more than a pound of corn a day if they have free access to all the alfalfa they want. To finish a Mexican lamb and fit him for market requires an average of about 400 pounds of alfalfa and from 100 to 125 pounds of grain, the expense varying with the cost of hay and grain.

Practically the feeding methods employed in Larimer County are followed in all the feeding districts of the State.

The Mexican lamb, which is most sought after by feeders and packers, is a descendant of the Spanish Merinos, which were introduced in Mexico at a very early date. The influence of a dry warm climate and successive years of inbreeding caused them to deteriorate in character and quality as wool producers. The fleece is lighter and much poorer in quality and the bone smaller. The reason why butchers and packers prefer the finished Mexican lamb is that it dresses out a higher per cent of mutton; and the flesh, when fattened on alfalfa and corn, is whiter, sweeter, and more attractive to the consumer.

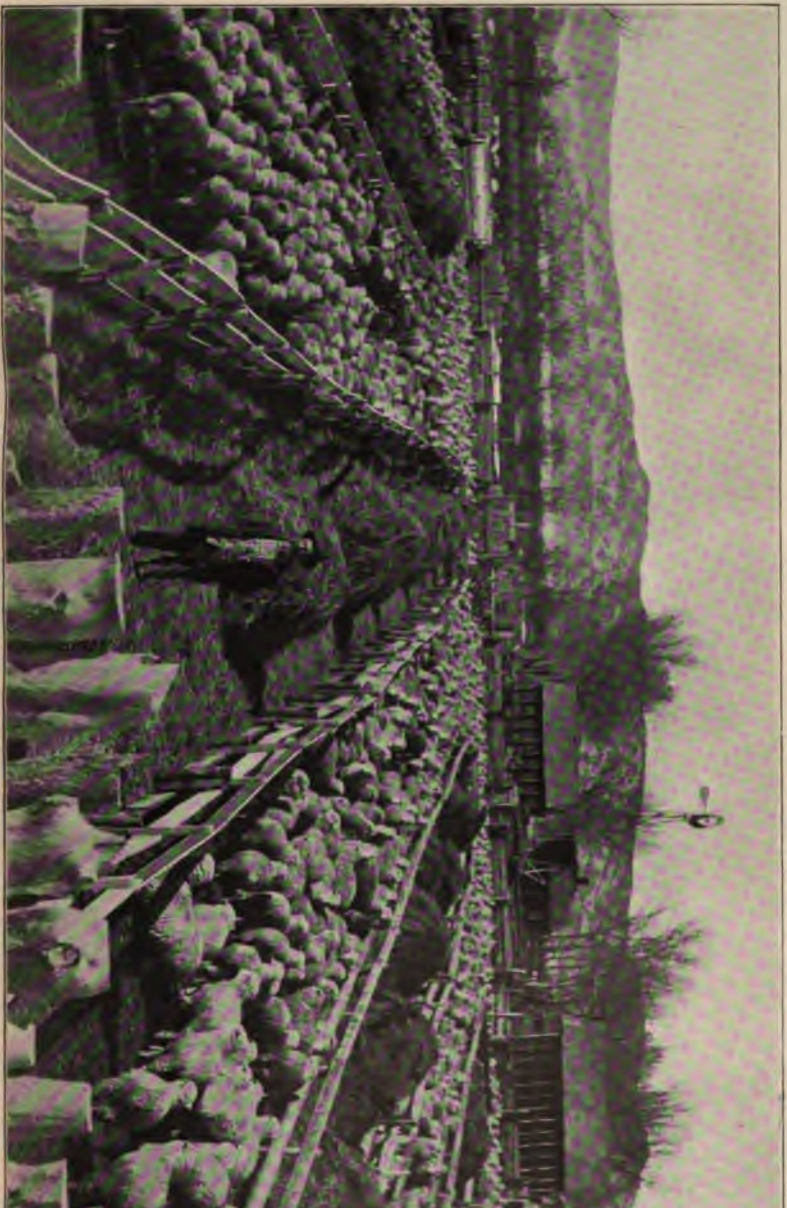
Of late years, however, the Mexican woolgrowers have been grading up and improving their flocks by crossing them with the fine-wooled and heavier mutton breeds, and it is only a question of time when feeders can no longer secure the small-boned, coarse-wooled Mexican lamb for his feeding pens. Feeders prefer lambs from 6 months to 8 months old for fattening purposes. The price paid for lambs in New Mexico has varied during the past twelve years, ranging from $1.35 to $2.80 per head, freight paid to the Missouri River. Of late years about 20 per cent of the lambs fed in Larimer County have been shipped in from Idaho, Utah, and Wyoming. These lambs are larger boned, heavier wooled, and heavier in weight than the Mexican lambs, and have cost the feeders all the way from $1.19 to $3.50 per head, freight paid to the Missouri River.

Lamb feeding is a business that affords employment and an assured living to people of small means as well as to those in better circumstances, and has gone a long way toward solving the question of what a poor man can do in Colorado. In the early history of the industry nearly all the feeders depended upon the local banks for the capital needed to buy the lambs and corn required. At the present time but few are compelled to ask favors of the banks, the most of them doing business on their own money made at sheep feeding.

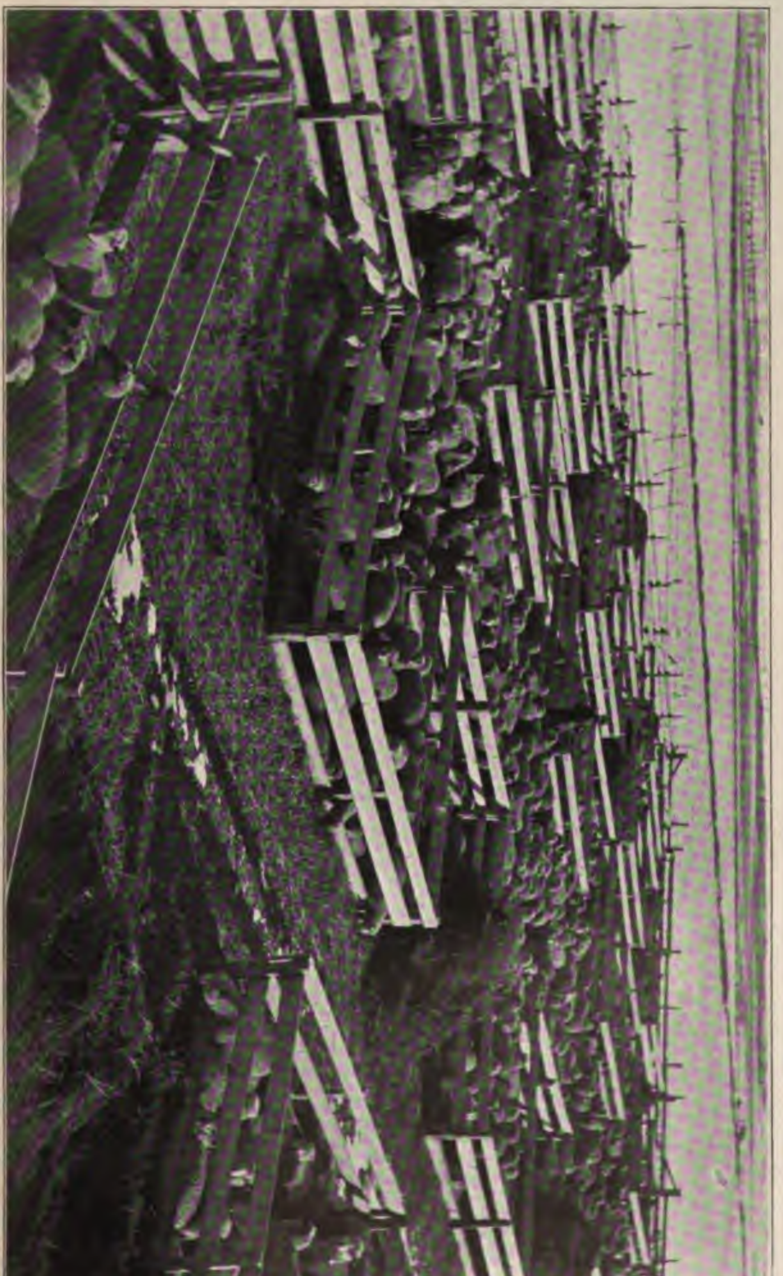
The amount of money invested in the business, including first cost of lambs, hay, grain, freight, and commission, has averaged nearly $1,000,000 during the past five years. The industry generally affords the farmers good prices for hay and grain and the time employed, for which there would otherwise be but a moderate demand.

There are many details connected with the business which have not been touched upon, only the leading features being presented; but enough has been said to make it clear that lamb feeding for the Colorado farmer is successful and profitable.

PLATE XVII.



SHOWING METHOD OF FEEDING HAY. STRAIGHT FENCE.



SHOWING METHOD OF FEEDING HAY. ZIGZAG FENCE.

CATTLE MARKETS AND ABATTOIRS IN EUROPE.[a]

By Henry E. Alvord, C. E.,
Chief of the Dairy Division, Bureau of Animal Industry.

The principal cities of Europe have for a long time had the reputation of maintaining well-regulated markets for live animals for the meat supply and equally good slaughtering establishments. Among those worthy of note may be named Berlin, Budapest, Halle, Hamburg, Liverpool, London, Mannheim, Paris, and Rotterdam.

AT PARIS, FRANCE.

PROVISIONS FOR HANDLING STOCK.

Paris has been particularly noted in this respect. Prior to the year 1865 the cattle markets for this city were several in number and much scattered. The markets of Sceaux, Bernardins, La Chapelle, and the Calf Market belonged to the city and were conducted by it. Those of Poissy and Saint Germain belonged to the communes within which they were located. At all but the last named, beef cattle and calves were sold. Sheep were found only at Sceaux and Poissy, and swine only at La Chapelle, and Saint Germain. The slaughtering places, although fewer in number, were equally dispersed. Early in 1859 a movement was made to concentrate all this interest. Laws were enacted, land acquired, buildings erected, and in the year 1867 the extensive cattle markets and abattoirs of La Villette were opened and have since been quite famous and often referred to as models. La Villette was formerly a suburb of Paris, but is now within the cordon of fortifications and in the northeastern section of the city, near the gate of Pantin. When selected for this purpose there was much vacant and low-priced land at this point, and about 100 acres were secured by the city. The Canal de l'Ourcq passes lengthwise through the territory occupied by this great establishment, and affords some facilities for transportation, which are, however, less and less used. The cattle markets are located on one side of the canal and the detention stables and abattoirs on the other. A branch of the belt railroad of Paris enters the market side, with roomy and fairly convenient terminal facilities. Most of the animals are brought to the market by this railroad, although a large share are still driven in by way of the nearest city gates.

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[a] From notes taken while in Europe in 1900 as representative of the Bureau of Animal Industry.

The principal structures for the markets are three immense sheds or covered yards, high metallic roofs upon iron frames and posts, with all sides open. Passing in at the main entrance from Rue de l'Allemagne, the central hall, directly in front, is the market for horned cattle. On the right and nearest the railroad tracks is the hall for calves and hogs, and on the left the sheep market. The capacity of these yards or halls is as follows: Steers, cows, and bulls, 5,000; calves, 2,000; pigs, 5,000 to 6,000; sheep and lambs, 30,000. There are accommodations elsewhere for about 300 milch cows. The interior fittings of all the large structures are of iron and stone, varied to suit their different purposes. The cattle stand on a raised stone floor, 2 feet above the general level of the yards; they are arranged in long rows, graded roughly as to quality, and are tied closely by horns or neck to horizontal iron rails about 3 feet above the floor in a way to permit very little movement. The distances between tie rails is so short as barely to afford room to walk along between the rumps of one row and the heads of the next. The hog shed is divided into pens of different sizes by iron fencing about 3 feet high. The fixtures for calves are the same. Sheep are arranged in long rows and double tiers, tied by the neck to a wooden hurdle, with a second one pushed up close behind them. This packing is extremely close, and almost suffocating in hot weather. Within all three of the big sheds are scales and weighing pens, inspectors' booths, and inclosures for other offices. The growing demands of the city have plainly outgrown the accommodations of thirty-five years ago, then ample, as various supplementary structures have sinced been placed wherever there was room, and with little uniformity, while additions are still being made between the canal and the Rue de l'Allemagne. The law requires the markets to be opened daily except Sunday, and there are always some animals on the premises and some business in progress, but Monday and Thursday are the general market days. The business days are divided as follows for sales of the different classes of animals: Bulls, 10 a. m. until 2.30 p. m.; steers and fat cows, 10.30 a. m. until 2.30 p. m.; calves, 10.30 a. m. until 2 p. m.; hogs, 11.30 a. m. until 3 p. m.; and sheep, noon until 3 p. m. Just as soon as the market closes the sheds are cleared and the premises are thoroughly cleaned and disinfected. This includes all stables and sheds as well as the big sales buildings. This semiweekly service employs 2 supervisors, 2 mechanics, 4 chiefs of squads, and 62 laborers. The disinfectants mainly used are bichloride of mercury and hydrochloric acid, 1 and 5 parts, respectively, to 1,000 of water. On Tuesday and Friday there are special markets for veal calves, and, there being no pigs then in the pens, there is ample room for several thousand.

Besides these large selling halls there are commodious stables for housing animals arriving after market hours or held over until the next sales day. These will accommodate 120 bulls, 3,000 steers and cows, 700 calves, 8,000 sheep, and 1,300 hogs. Sheep from other countries, and especially those from Germany and Austria-Hungary, when suspected of disease, are placed in quarantine in large sheds on the other side of the canal, reached by a spur railway track and hydraulic drawbridge. This quarantine station was instituted in 1890 and has since been enlarged so as to hold 15,000 sheep at a time.

SALES OF LIVE STOCK.

The horse market of Paris is in a different part of the city, at the angle of the Boulevards l'Hôpital and St. Marcel on the south side of the Seine. Wednesday and Saturday are the sale days, and the hours from noon until 4 or 5 o'clock. Twenty-five or thirty merchants reserve from 4 to 20 stalls for their regular use, and these sell about 5,000 horses annually. Seven times as many are sold under the public sheds or in the open yards. In 1899 the total entries for sale at this market numbered 39,502, including mules and asses as well as horses. One-fifth of the whole number were sold for food and sent to the special abattoir. Horses for work sold at $125 to $260 each, driving horses at $100 to $250 each, and others, including those for slaughter, at $36 to $120 each.

The principal statistics of the cattle markets follow, the four years being selected from the ten prior to 1900, which show the lowest and highest receipts. (The year 1900 was abnormal, owing to the added demand for food supplies at Paris, incident to the exposition):

Total annual receipts of live animals.

	1890.	1893.	1895.	1899.
Beef cattle	298,332	354,128	293,610	354,515
Calves	177,632	192,507	166,734	180,719
Sheep	1,052,633	1,899,584	1,667,862	1,933,409
Hogs	385,643	509,093	431,846	464,253

Disposition of animals in the table above.

	1890.	1893.	1895.	1899.
Cattle to abattoirs	202,608	221,061	182,215	220,821
Cattle reshipped alive	93,970	130,331	111,043	131,089
Calves to abattoirs	141,929	143,693	122,327	122,335
Calves reshipped alive	35,629	48,174	44,171	58,001
Sheep to abattoirs	583,506	1,204,307	1,111,029	1,254,756
Sheep reshipped alive	465,985	691,112	551,192	671,548
Hogs to abattoirs	143,450	199,583	171,728	196,775
Hogs reshipped alive	241,515	306,920	260,160	265,558

DETAILS OF THE MARKETS FOR THE YEAR 1899.

Arrivals of animals by railway and by highway (driven).

Arrived by—	Cattle.	Calves.	Sheep.	Hogs.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Railway	61	71	25	98
Highway	39	29	75	2

Receipts of animals raised in France and from other countries.

Source.	Cattle.	Calves.	Sheep.	Hogs.
France	354,265	180,719	1,895,363	464,263
Other countries	250	....	38,046	....

Months of maximum and minimum arrivals.

	Cattle.	Calves.	Sheep.	Hogs.
Maximum	July, October	August, June	October, November.	October, November.
Minimum	February, April	February, December.	February, April	April, February.

NOTES UPON THE FOREGOING STATISTICS.

The fluctuations in number of animals arriving at the markets is remarkable; almost twice as many sheep in 1893 and 1899 as in 1890. And the year of greatest arrivals was the same for all kinds of food animals. The demands of Paris do not vary in like proportion; this is shown by the reshipments of animals to points outside the city, being much the greatest in the years of greatest receipts. The animals sent away include two classes—those taken by butchers for the meat markets of the city suburbs and places more or less dependent upon Paris for food supplies and those bought by grazers and feeders and returned later in better flesh. The increased arrivals in 1893 and 1899 are accounted for by outbreaks of contagious disease, owners striving to sell their cattle as an alternative to possible losses by death.

The very large number of calves received and used in Paris, in relation to the beef cattle, is noteworthy and indicative of the popularity of veal in the meat markets of the city.

It is interesting to note the large percentage of arrivals by the highway, or driven on foot, of cattle, calves, and especially sheep, while nearly all the pigs came by railway.

The use of foreign animals is extremely small, showing how fully France supplies her markets with home-grown fresh meats.

The sheep credited to France, however, include (for 1899) 209,596 from Algeria, and in 1898 there were 276,000 received from this colony. The 38,046 sheep imported were received from Germany (18,456), Austria-Hungary (11,620), America (4,138), Russia (3,051), and Montenegro (781). Of the very few live cattle imported nearly all came from America.

The monthly receipts of all classes of animals varied (in 1899) very much less than would be expected; in cattle not over 20 per cent and in sheep about 30 per cent.

The geographical divisions of France contributing in greatest numbers to the live-stock markets of Paris are these: For cattle, the departments of Calvados, Vendée, Orne, Lower Loire, and Maine each sent from 24,000 to 35,000 in 1899; for calves, the departments of Aube, Sarthe, Eure-et-Loir, Lot, and Marne each sent over 13,000; for sheep, the departments of Seine-et-Marne and Seine-et-Oise each sent over 120,000, and those of Aveyron, Aisne, Cantal, Finistère, Loiret, Lot, and Tarn, each 60,000 or more.

The milch cows sold at La Villette ranged from 106 in January to 394 in May, the total for the twelve months of 1899 being 2,514.

WEIGHTS AND PRICES OF CATTLE AT LA VILLETTE MARKETS.

The average live weights of the animals handled at this market in 1899 and the percentages of dressed meat (or net) are shown in the following table:

LIVE WEIGHTS AND DRESSED MEAT AT LA VILLLETTE.

Classes of animals.	Large.		Medium size.		Small.	
	Live weight.	Dressed meat.	Live weight.	Dressed meat.	Live weight.	Dressed meat.
	Pounds.	*Per cent.*	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*
Steers	2,420	65	1,650	58	880	54
Bulls	2,200	63	1,540	58	825	52
Cows	1,980	60	1,430	55	770	50
Calves	550	64	330	60	121	55
Sheep	165	49	110	44	55	40
Pigs	594	80	308	74	143	70

The largest and best beef animals shown above to be very heavy and well fatted are of the white breeds known as Charolais, Nivernais, and Bourbonnais. As elsewhere, two distinct classes are known as grass-fed and stall-fed. This market also handles a third class called "sucriers," because they are fatted upon beet pulp, the refuse of the beet-sugar factories. The medium-sized beef cattle include the Normandys and Limousins, and the small ones are all from Brittany or Algeria. The heaviest calves—and they are wonderfully large and fat—are grown in the Champagne country, in Calvados and Auvergne. For pigs the Parisian pork merchant pays the highest price for those which range in weight from 220 to 330 pounds alive.

Sales of live animals at La Villette markets are made (1) according to net weight of dressed meat as judged by the eye, and (2) by actual live weight. Cattle, calves, and sheep are almost exclusively sold by the former method. The swine are always weighed and sold by live weight. The average prices obtained for animals of different kinds per 100 pounds net weight of meat during the years 1898 and 1899, with the highest and lowest prices for the latter year, are given in the following table:

Prices per 100 pounds at La Villette markets in 1898 and 1899.

	Steers.	Bulls.	Cows.	Calves.	Sheep.	Hogs.
Average 1898	$12.45	$9.36	$11.55	$15.82	$15.00	$12.73
Average 1899	11.11	8.91	10.54	15.18	15.00	13.27
Highest 1899	12.45	9.45	11.64	16.55	15.27	13.82
Lowest 1899	10.27	8.45	9.91	13.46	14.54	12.64

It must be remembered that these are the prices paid for the animals while on the hoof, based upon estimated net weights; all seem very high, and especially those for veal and mutton. There was a steadily declining market for beef cattle and calves in 1899 from January to December, but a remarkable uniformity in the price of sheep and very little fluctuation in hogs.

The sales may be made by the owners themselves, but it is usual to employ commission men. The charges of the latter are as follows: Beef cattle, 60 cents to $1 per head; calves, 30 to 40 cents per head; sheep, 6 to 10 cents per head, and hogs, 15 to 30 cents per head. An exception is made in the case of imported sheep sold at the quarantine, where the commission is fixed at 1 per cent on the gross sale.

The various expenses of this market, to which all animals are subjected, and which must be paid by the sellers, unless otherwise specially agreed, are worthy of notice. If the animals are imported, they may enter La Villette in bond, but when sold must pay customs duties as follows: Beef cattle, 10 francs per 100 kilograms live weight, or a little less than 1 cent per pound; calves, 12 francs; sheep, 15.50 francs, and hogs, 8 francs. Besides this regular duty, there is a charge of 2 cents per head upon all, for "statistics," or records; and for the required sanitary inspection, necessary before sale, 10 cents per head on cattle and 2 cents on the small animals. There are three items of expense which all animals must pay which arrive by rail—transportation, unloading and handling, and disinfection of cars. The rates per head follow:

Transportation: Cattle, 2 cents; calves and hogs, 1 cent; sheep, 1 cent.

Unloading, etc.: Cattle, 20 cents; calves and hogs, 8 cents; sheep, 4 cents.

Disinfection: Cattle, 6 cents; calves and hogs, 3 cents; sheep, 1 cent.

For transportation the rate given is per head and per kilometer, or about 3 cents per mile on cattle; but this rate is for single animals or a few, and carload rates are not more than half as much, varying on different lines and particularly when the distance is great. Next come the general market fees to which all animals entering La Villette are subject and which go to the city treasury, namely, entrance fee, stable fee (if remaining overnight), and disinfection fee. The rates per head (and per day for stabling) follow:

Entry: Cattle, 60 cents; calves, 20 cents; sheep, 6 cents; hogs, 20 cents.

Stabling: Cattle, 10 cents; calves, 4 cents; sheep, 1 cent; hogs, 5 cents.

Disinfection: Cattle, 5 cents; calves, 2 cents; sheep, ½ cent; hogs, 3 cents.

There are additional charges in case animals are found to be sick or suspected and placed in quarantine; all foreign sheep sent to quarantine pay regularly 2 cents per head besides the fees already enumerated. The public weighing scales, of which there are eight, charge 10 cents per live hundredweight.

The various market receipts for 1899 were as follows:

	Francs.
Entry fees	2, 288, 540
Stabling fees	201, 819
Quarantine fees	3, 585
Disinfection	224, 674
Weighing	105, 035
Sundries	29, 793
Total francs	2, 853, 446

Or about $570, 000.

The general health of animals entering the market is shown by the fact that in 1899, a year of unusual sickness among cattle and sheep in France, the sanitary inspectors found only 1,128 affected or suspected of contagious disease out of a total entry at La Villette of 2,933,366 head of all sorts.

THE ABATTOIRS OF PARIS.

Two large, high-arched, double bridges of masonry, with separate passages for cattle, vehicles, and pedestrians, and with convenient approaches, span the canal and connect the markets or stock yards with the abattoir area of 40 acres. The main approach to the latter, however, is from the Rue de Flandre. A large paved space is first entered, known as the Court of the Clock, in the midst of which is the building occupied by the offices of the city managers of the establishment, the city tax officers, the veterinary sanitary inspectors, the police, and the auctioneers. Near by is a pavilion used solely as a wholesale meat market, and known as "the market of reassortment" or redistribution. At the extremity of this court the principal buildings of the abattoir are located upon three diverging avenues and arranged in groups, separated by streets perpendicular to the avenues. On either side of the central avenue are large structures of stone and brick, with tile roofs upon iron frames. There are twelve on one side and eight on the other, placed with ends on this avenue and extending to those on the sides. These buildings are set about as far apart as their own width and in pairs, the space between every pair being covered by a high roof of iron and glass, and closed at both ends with strong fencing and gates. These ten large sheds, paved and covered, are called the working courts. To them the animals are first driven from the markets, and either turned in loose, awaiting slaughter, or tied to rings along the sides of the buildings. From these courts are entrances direct to the abattoirs proper, or butchering pens, into which most of these large buildings are divided. The structures at the front, or nearest to the Court of the Clock, are assigned for beeves and large animals, and those farther down the avenues for the smaller animals. Only one building is specially fitted for butchering hogs. As stated, most of the twenty buildings described are divided by brick partitions into stalls or rooms of different sizes, where the active operations of slaughtering are carried on; there are in all about 200 of these apartments, each having its own small set of men. As a rule, the work done in each of these is for one particular party and under his own supervision, subject to the general inspection service of the premises. Under certain formalities and rules the abattoir stalls are thus assigned to the use of different owners of cattle or merchant butchers. These killing rooms are by no means first class in arrangement or management. They are little less than bare pens, with no conveniences except an abundance of water. Some have hoisting appliances, but very primitive. The animals are driven or dragged from the yards, killed on the floor with poleax or knife, and skinned where they fall. As the dressing proceeds, the carcasses are moved across the building to or near a door into the open street which separates every pair of abattoirs. At this point in every room, or set of rooms, are facilities for hanging sides of beef and small carcasses. Blood is saved in barrels and solid manure is carted away at frequent intervals to a remote shed. Hides, horns, heads, feet, and other offal are piled about the place, to be removed at leisure. The floors throughout are stone or cement, but none too good; the stones are about a foot square and often unevenly laid. But drainage appears to be sufficient, and with an ample water supply the rooms can soon be cleaned. The building for hog killing is very large and has special fittings; it is divided into small stalls by brick partitions. In these stalls the animals are stunned and bled, and the blood saved in metallic vessels. The bristles are then pulled with a hook, after which the carcasses are placed on beds of dry litter, covered with straw, and the latter burned. A strong draft chimney carries away the smoke from the burning litter and hair. The carcasses are then carried to the hanging room, where they are scraped, the entrails removed, the heads taken off, and finally cut in halves. On the outer flank of either side avenue are supplementary buildings assigned to various objects, such as rendering tallow and lard, preparing tripe, making sausage, salting hides, handling feet, etc. The general arrangement is somewhat irregular because of the shape of the available land. On the outskirts of the premises there are quite a number of wooden structures, used for storage and various purposes. Altogether there are ninety buildings, covering an area of 25 acres.

The dressed meats are hung up in what may be called the outer ends of the transverse divisions in the slaughterhouses, where it is cleanest and where there is the most movement of the fresh air. The carcasses of veal and mutton are hung whole; those of pork usually in halves. The beef is in sides, or at least never quartered as in this country. The fore leg is often removed at the shoulder blade and the neck and fore shoulder cut off; then the hind leg and rump are removed beyond the last rib, making a very long loin. Sometimes the side goes to market with only the legs taken off. This meat is frequently hung on portable frames, which can be moved out of the building or placed directly in the drafts from the doorways. Atmospheric air is the sole reliance for cooling the meats. The latter may be well washed down as a slight aid, but the water available in warm weather is not cool enough to do much good, and it is certainly not antiseptic, but rather the reverse. With the entire absence of facilities for cooling and firming freshly killed meats, and with the conditions as described, it is evident that during a large part of the year the meat must be hurried off to market. It is never properly seasoned or "ripened," and in warm weather it does not get stiff enough to handle well, but remains soft and flabby. As a consequence, no meat is stored at the abattoir, and only enough dressed from day to day to supply current demands. In hot weather the slaughtering is done late in the afternoon or even after sunset; the meat is in the wholesale market early the following morning, and in the retail shops fifteen or eighteen hours after the animals are killed, or even less. A branch of the French weather service is maintained at La Villette and the frequently posted bulletins are closely watched; changes of barometer, temperature, winds, and cloud conditions are carefully noted by those concerned in slaughter and the purchase and sale of meats.

The prejudice of the French people against fresh meats and poultry which has been frozen, or even artificially chilled, is remarkable and inexplicable. It results in very heavy losses in hot weather, especially in the thousands of little butchers' shops scattered all over Paris, also in the wholesale stalls at the great central markets and sometimes even at the abattoirs. The sanitary inspection service is very rigid, and meat is condemned, confiscated, and destroyed as soon as it becomes tainted. Chemical preservatives are absolutely prohibited, although considerably used surreptitiously in the retail trade. During the year 1899 the inspectors seized and condemned at the abattoirs 34,020 pounds of fresh meat of all kinds. A part of this was on account of disease which had escaped the inspectors at the stock market, but most of it was because of decomposition occurring after slaughter. If seized upon the day of arrival of the animals, the shelter fees are remitted.

At one corner of the abattoir property at La Villette is a large, rather dilapidated building, conspicuously marked "Usine Frigorifique." This is a freezing factory, or, in other words, a cold-storage warehouse. It was built by the subsistence department of the French army some years ago, and intended as a safeguard against a possible period of meat famine, as in a time of siege. It has never been used by the Government and its commercial use has never been permitted. It is said, however, that the refrigerating machinery was never efficient, and that for a long time it has actually been absolutely worthless. In the year 1900 there was only one other place in France where cold storage on a commercial scale had been attempted. Several years ago a cold-storage plant of considerable size was built at Havre by a company which proposed to do a large business in frozen mutton from Algiers and Argentina. But the French prejudice against frozen meat was too strong, and this venture was a financial failure.

It should be added that recently there has been an earnest movement in France toward the commercial application of refrigeration for the preservation of perishable food products in general. A Government commission has the subject under investigation. Without awaiting the result of this inquiry, Mr. Charles Bossez, an enterprising wholesale butcher, has, with very little encouragement and assistance, repaired the old plant at Havre and opened it for general storage, besides constructing a small cold storehouse for use in connection with his business in Paris.

Sales of meat are made at the killing pens according to the net weights obtained there and subject to certain commercial customs which differ with the kinds of cattle. For beeves, the head, feet, pluck, and intestines are not weighed or sold with the meat; from the net weight of meat deductions are made of 13 pounds on account of the "swelling" of the animals, of 11 pounds for the cheeks when remaining attached to the neck, and of 2 pounds for "heat," or expected evaporation and shrinkage. The tongue is not weighed; it belongs to the buyer of the carcass and he has the right to take it, but if declined, he is allowed 40 cents off on his payment. For veals, the head, feet, pluck, and intestines are not weighed. With mutton, the same, except as to the pluck, which remains attached to the carcass usually, and an allowance of 3¾ pounds is made for it. In the case of pork, the fore feet, head, and pluck are not weighed with the meat, but the hind feet are very generally left attached to the carcass and included in net weight of meat.

The principal statistics of the abattoir follow, the year selected being for reasons already stated.

Receipts at abattoir of La Villette for the year 1899.

Classes of animals.	Total entries.	How arrived.			Net weight, dressed meat.	
		From cattle market.	Direct by belt railway.	On foot (driven).	Average per head.	Total.
	Number.	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds.*	*Pounds.*
Cattle	245,745	79.6	19	1.4	757	185,763,727
Calves	220,413	52.1	13.9	34	156	34,183,767
Sheep	1,680,381	68.3	9.1	22.6	42	70,397,011
Hogs	200,315	80	15.6	4.3	160	32,450,231

The countries from which these animals came, and months of maximum and minimum receipts, have been already shown by a preceding table. (See p. 282.)

The disposition of the dressed meats of all kinds was as follows: Grand total for the year, 322,794,767 pounds; to Paris butcher shops, 242,552,070 pounds; to Paris pork shops, 31,625,336 pounds; outside of city butcher shops, 47,792,465 pounds; outside pork shops, 824,895 pounds.

A distinction is made between general butchers, or meat dealers, and pork merchants, because in Paris pork and all its products and derivatives are sold in shops by themselves (*charcuteries*), where no beef, veal, or mutton is to be found. At La Villette abattoir, in 1899, there were killing privileges leased to 312 "merchant butchers" and 22 "pork merchants."

The average wholesale price of beef at La Villette during 1899 was 11½ cents per pound, being highest in January and May and lowest in August; for veal, 15 cents, highest in January and lowest in July; for mutton, the same as for veal; and for pork, 14½ cents, highest in March and April and lowest in November.

The wholesale meat market already mentioned as located near the front of the abattoir property, has been transacting a rapidly increasing business. In 1899, the total quantity sold was 16,921,764 pounds of meat, being double the sales of seven years before. Nearly 92 per cent of this business was effected at private sale (*vente à l'amiable*) and the remainder at public auction (*vente à la criée*). Most of the private sales are conducted through middlemen, factors, or commission agents, of whom 22 are registered for business at this market.

The expenses in connection with slaughtering and the sales of meat at La Villette abattoir are as follows, the rates all being upon 100 pounds actual weight of butchers' meats and uniform for all kinds: (1) The octroi, or city tax (levied at varying rates upon nearly all food sold in Paris), 88 cents; (2) for "shelter" fee, storage, or occupation of general premises, 19 cents; (3) the killing fee, or abattoir charge proper, 18 cents; (4) weighing fee at public scales, not quite 2 cents; the total is thus just about 1¼ cents per pound from the time the animal reaches the abattoir until its edible carcass is ready to go to the retail shops, and reckoned upon net weight of carcass.

During the year 1899, these taxes and fees, with a few minor occasional charges, produced an income of 15,678,593 francs, or about $3,150,000. Of this amount a little over $700,000 was credited to the abattoir, giving the city a handsome profit on the establishment apart from the octroi.

There is another abattoir owned by the city and located in a different section which is of much less importance, although its business is considerable. The Abattoir of Vaugirard is bounded by Dantzig, Morillons, and Brancion streets. During 1899 the receipts there comprised 42,267 cattle, 46,229 calves, 317,879 sheep, and 120,405 hogs, and turned out a grand total of 65,567,148 pounds of dressed meats. These figures show that its principal business is with the smaller kinds of food animals.

Paris has still another slaughterhouse controlled by the city, not large, but peculiar. The abattoir of Villejuif made the following returns for 1899:

Number of animals slaughtered at Villejuif, 1899.

Horses	17,042
Asses	190
Mules	18
Total	17,250

These animals produced 9,422,820 pounds of dressed meats, an average of 554 pounds per head. This class of animal food was all sold by five merchants in Paris, specially licensed to sell this meat and no other.

It should be noted that, although the statistics heretofore given represent the business of the principal cattle markets and abattoirs of Paris—a description of which is the object of this writing—the figures do not at all represent the total meat supplies of the city. The meat markets, wholesale and retail, obtain about three-fourths of their total supplies from the abattoirs; the other fourth is brought as dressed meats from without the city limits by highway vehicles, by water (especially boats on the river Seine), and by five different lines of railway. The total receipts in Paris, from all sources, for the year 1899, were reported as follows: Beef, veal, and mutton, 360,297,770 pounds; pork, 59,952,195 pounds; pork products, 6,305,174 pounds; horse meat, etc., 13,049,630 pounds. This makes an aggregate of 439,604,770 pounds of butchers' meats for one year as the supply for the 2,600,000 inhabitants of Paris.

AT MANNHEIM, GERMANY.

The model abattoirs and cattle markets of Europe at the present time are to be found in Germany. This is conceded by the French authorities as well as by others. There are extensive and well-equipped establishments in several large cities, but those which are the newest, with latest improvements and regarded as the best of all, are at the old university town of Halle and at Mannheim on the Rhine. These are almost duplicate plants, and a description of either will suffice.

Mannheim is a city of 80,000 inhabitants, situated upon the tongue of land at the junction of the rivers Rhine and Neckar. The old town is built on the point and connected by fine bridges with suburbs upon the opposite banks of both rivers. For a century or more Mannheim has been quite noted in that part of Europe as a cattle and horse market, and local laws governing this traffic date from 1822 and were quite frequent up to fifty years ago. Between the years 1850 and 1865 the stock markets were held on the edge of the city, and the abattoir was on the banks of the Neckar. In 1865 the cattle market was moved from the general food market and definitely assigned a location near the Heidelberg gate, which was where the city water tower now stands. A market for fat cattle, which had previously been regularly held at Heidelberg, was then discontinued and united with the weekly markets and the special monthly market at Mannheim. A large building was erected by the city at that time and smaller ones have since been added. The business of the market increased steadily and the city grew in its direction, upstream or inland, so that it became necessary to select a new location and one directly accessible from the railways. This was accomplished by the assignment of a large, square tract of about 25 acres in the new southeastern section, beyond the great circular boulevard and the finest city park. Ground was broken in 1889, and live-stock markets first held upon the new site in January, 1892.

As early as 1728 there were two city abattoirs, one for Jews, located on the Rhine near the drawbridge, and one for Christians, on the Neckar, outside the city, near the Neckar gate. These two buildings were respectively replaced, in new locations, in 1837 and 1869. In 1890 it was decided to construct a single new abattoir in connection with the new market, but the work was not actually begun until December, 1896. The ample space permitted building upon a well-considered, symmetrical plan and on a liberal scale. The present abattoir was completed and opened for use in May, 1900.

The railways approach the grounds from the west, enter at the southwest corner, and four or five tracks extend along the entire side of the big square, just inside the south wall. There is also a turntable near the railway entrance, and a spur track extends northward next to the west wall, giving access to several of the large buildings. There are thus exceptional facilities for loading and unloading different kinds of animals and freight. Animals arriving upon cars are discharged directly upon a sort of levee, or slightly sloping platform of stone, upon which are iron-fenced yards or pens—twenty of these for large cattle and five for small. All animals are inspected here before being permitted to pass to the stables or public market. If found diseased they can be easily reshipped, and doubtful cases go to a large quarantine building, apart from the rest, near the southeast corner of the premises. In that extreme corner and across the ends of the track is a special platform for unloading from cars which open at the end. This is also the place for unloading forage. Midway of the line of car tracks, convenient alike to stock yards and abattoirs, are five large wall pits for manure and offal, with special conveniences for hoisting, loading, and shipping. At this point, also, the tracks are broken to provide a scale and weigh-house for weighing carloads of anything arriving or departing.

The square area is divided into two nearly equal parts by a masonry wall running north and south, at right angles to the railway. In this there are but three large gates; these have their gatehouses and gate men, so that the two general parts of the establishment may be independently managed and traffic between them fully controlled. Near the end of this division and in the center of the north front of the premises is a handsome administration building, surmounted by a lantern tower and surrounded by broad courts and driveways. The exterior walls of the establishment curve around this building so as to leave it outside the inclosure. This building contains the general offices, especially those for the director and the cashier of stock yards, markets, and abattoir, which are administered as a unit and the private quarters of the first-named officer. Attached to this building at its rear is a covered weigh-house for vehicles arriving or departing, and directly south of this, in the curve of the wall, the gate keeper's lodge with a large gate on either side by which the stock yards and the abattoir sections are, respectively, entered from the city approaches.

Directly west of the administration building but inside the walls is a substantial stone building of two stories and basement occupied as an exchange and for convenience of employees, merchants, and visitors.

It contains reading and writing rooms, a telegraph office, restaurant, and kitchen. Adjoining this building is a garden, and a large court remains unoccupied in the northwest corner of the premises. On the opposite or east side of the administration building, extending along half of the north front, inside the wall and into the corner, is another garden, large and ornamental; this occupies a considerable area which will be available for future buildings.

STOCK YARDS AND MARKET.

The stock yards and market occupy the half of the inclosure east of the central dividing wall. This section comprises four parts: (1) The railroad and terminals already described; (2) the stables or waiting houses, used also as covered market halls; (3) the open market spaces, or yards proper; and (4) the area now surplus except as used annually for the great May market. The stables are grouped in five or six rows, with their ends toward the railroad, and alleys between, so that the buildings for different classes of stock are directly accessible from the railway, and at the same time the alleys can be used for conducting animals at once to the market yards. The building on the west, and the largest of the group, is for small animals; the south half nearest the tracks is for hogs, and the other half for calves; between these sections is an office, a kitchen for stockmen, and a cellar. This building is roomy but low, in order to be comfortable in winter; its interior is protected from summer heat by the simple device of a double roof, air moving freely between the two coverings. Inside both sections are divided into good-sized pens, by aisles running lengthwise, and cross passages. In extreme diagonal corners are small offices for weighmasters and pen scales, suitable for small cattle. Next east are two buildings of similar character for beef cattle; they contain twenty compartments, each of which will accommodate 30 large animals. Still farther east, five stables for horses, with capacity of about 60 head each, and room for at least one more building. Against the east wall is a large building which can be used for quarantine, and over which there are big lofts for forage. Just north of this and separate are the special offices for the May market. All of these buildings are of stone, iron, and glass, and the interior divisions and fittings are all ironwork.

North of these stables and arranged in symmetry with them is the open market space, divided into inclosures of several sizes by substantial, plain, iron fencing (see Pl. XIX). There are accommodations here for 1,200 large cattle, with opportunity for expansion to twice that number. Like all the stables, this area is stone paved and well drained, roomy, convenient, and easily cleaned. It can be reached directly from the railroad, as described, and also from the gate on the city side.

Against the east side of the central division wall, opposite the calf hall, is a row of twenty or more close boxes or stalls for milch cows, fractious bulls, or animals injured or temporarily sick. During the May market these boxes are occupied by race horses. Against the same wall, farther north, are horse stables and vehicle sheds, for the use of officers, employees, and visitors, and a waiting room for drivers and servants.

In these buildings, stables, and yards every inch of floor and pavings, walls, partitions, inclosures, and fixtures can be subjected at will to streams of hot and cold water under pressure, and to live steam. All parts are habitually cleaned and disinfected immediately after the close of a market.

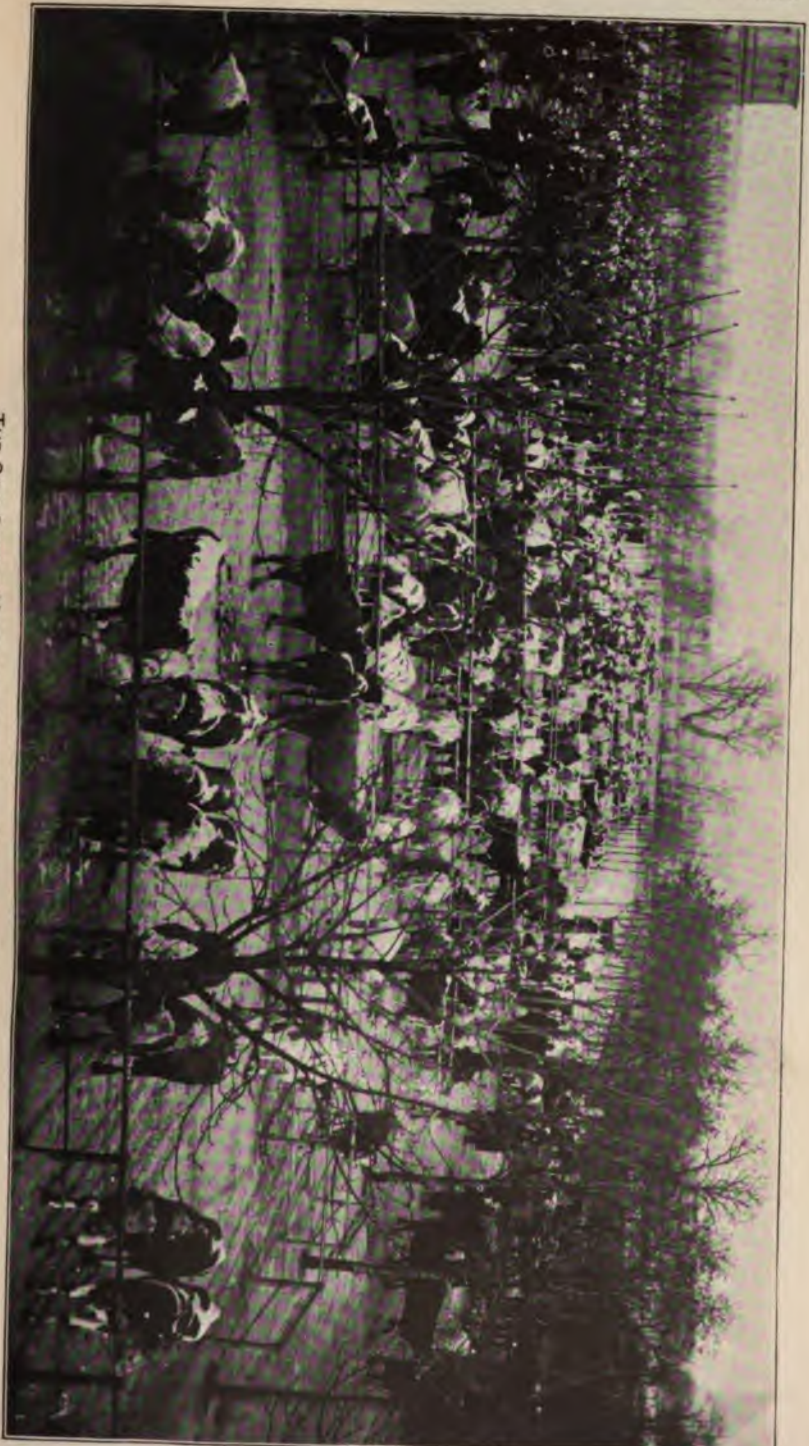
As already stated, there is much room remaining for additional buildings or other occupation. That now in use is laid down to grass, and rows of shade trees line the avenues and passageways and fill otherwise vacant corners, giving an air of hospitality and comfort to the whole premises.

Plate XX gives a plan of the entire inclosure, showing the arrangement of the market and the abattoir. The purpose of the principal buildings is marked on the plan and others are explained by the accompanying key.

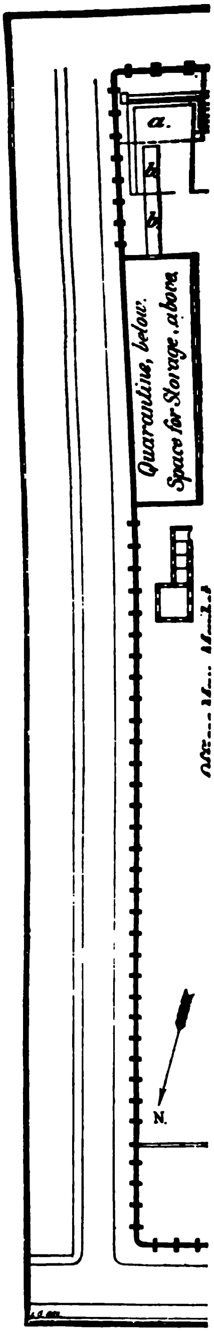
The business of this market and its growth is shown by the total annual receipts of animals, reported as follows:

Year.	Total head.	Year.	Total head.
1880	52,044	1897	140,438
1885	61,243	1898	154,518
1890	74,891	1899	174,634
1895	119,752	1900	182,664

The division by classes has been about the same all along, and was as follows for the year 1900: Bulls, 1,519; work oxen, 2,113; steers and fat cows, 42,218; milch cows, 1,541; calves, 24,784; hogs, 92,562; sheep and lambs, 2,436; goats, 361; "sucking pigs," 11,406; and horses, 3,724. Omitting the little pigs, the Mannheim officials group the foregoing as 47,391 large cattle, 3,724 horses, and 120,143 "small cattle." The notable feature of this market, in the matter of receipts, is the extremely small number of sheep and lambs and the large number of sucking or lately weaned pigs. The latter were nearly all sold to be raised in the neighborhood and brought back to swell the supply of hogs. Mannheim has long been famous as a market for little pigs, supplying the whole country around. At times from 400 to 500 per week, or 20,000 to 25,000 a year, have been the usual numbers sold here. Lately a rival market has been established at Seckenheim, and this has caused a serious falling off in this branch of the Mannheim trade.



The City Cattle Yards and Market at Mannheim, Germany.



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The range in prices for these animals during the year 1900 is given below, per 100 pounds of dressed weight or per head, with the months when the highest and lowest prices prevailed:

Classes of animals.	Value.		Highest.	Lowest.
	Dollars.			
Bulls per 100 lbs.	11.34 to	12.65	Dec	May.
Oxen do.	12.22	16.19	Nov	May.
Steers, etc do.	7.68	14.82	Sept	Dec.
Milch cows per head.	24.00	192.00	Apr	Dec.
Pleasure horses do.	240.00	1,200.00	May	Oct.
Work horses do.	24.00	480.00	Apr	Nov.
Food horses do.	5.00	36.00	Oct	Dec.
Calves per 100 lbs.	12.00	19.63	Mar	Nov.
Hogs do.	8.75	13.00	Oct	Mar.
Sheep do.	8.75	17.50	Oct	Dec.
Goats per head.	2.50	6.00	Nov	June.
Little pigs do.	1.00	3.60	May	Sept.

General regulations governing the live-stock market are enacted as laws and are strictly enforced: (1) No cattle of any kind can be exposed for sale at any other place in Mannheim. (2) Domestic animals of every description, including dogs and poultry, may be sold at the market place. (3) The regular sales days are as follows: Cattle for slaughter and milch cows, Monday and sometimes Friday; horses, the first and third Monday, every month; calves, sheep and goats, Monday, Wednesday, and Friday; hogs, daily; fowls and dogs, Monday; sucking pigs, every Thursday; a special and very large "May market" is held on the first Tuesday of that month and continues through the week; if a Christian or Jewish holiday falls upon any market day, the market is held the day following, Sunday excepted; placards at the market a week in advance announce these postponements. (4) Calf markets begin at 10 o'clock a. m.; all others begin at 9 a. m.; all close at 1 p. m.; the opening and closing of the market are signaled by a big bell in the water tower; no sales can be made in the market outside of hours prescribed; the city council has the right to change market days and hours. (5) All animals brought to the city for trade, sale, or slaughter, including those handled by regular dealers and butchers, must be taken directly to the quarantine grounds of the market, and held until passed by the sanitary inspectors. (6) Excepting the hours for markets, admission to the yards requires special permit from the director. (7) All help and labor of every kind connected with the market—unloading, driving, handling, weighing animals, etc.—must be done by the employees of the establishment, regularly licensed by the director and provided with certificates; all compensation to such persons is left to agreement between the parties interested, based upon the nature and length of the service; in cases of disagreement, the director is the arbiter, and from his decision there is no appeal. (8) The orders of the director upon all matters, that of the official veterinary surgeon regarding all sanitary police questions, and those of the subordinate employees within their respective jurisdictions, must be properly obeyed, without challenge, by all concerned. (9) Cattle may enter the yards at the main gate or by rail; all brought into the city by rail can be unloaded only at the yards and pass under its regulations. (10) Animals brought by wagons must be taken inside the yards before unloading; that must be done at the place designated, and the vehicles must then go to the proper place, to remain until disinfected and discharged. (11) The veterinary inspector decides not only as to health but also as to maturity and general suitability for slaughter; calves must be at least 2 weeks old; all animals are to be inspected as soon as practicable after arrival at the yards; the force is intended to be such as to keep no animals waiting over two hours. (12) Cattle coming from certain districts must be accompanied by health certificates. (13) No animal may be sold more than once on the same market day. (14) There are special regulations to govern treatment and disposition of animals found to be diseased or suspected of contagious disease upon arrival; also for disinfecting vehicles and railway cars. (15) Bulls may be moved in the yards only by two men with two strong ropes or by nose ring and staff. (16) Every owner or dealer bringing cattle to the yards must have all marked by his permanent mark or sign, and the same must be registered at the office; butchers must also adopt and register similar marks or brands. (17) Every animal which enters the market, after inspection, must be taken directly to the section appropriate for its kind; only large animals are allowed in the open spaces, and there every one must be securely tied. (18) Within one-half hour after the close of market every animal must be removed by the then owner. (19) These things are prohibited: (*a*) Bringing into the inclosure food or straw for the exhibited animals; (*b*) crying out or special noises to attract attention; (*c*) smoking in stables and storerooms; (*d*) loose dogs on the premises. (20) Special laws provide penalties for neglect or disobedience of the stock-yards regulations.

The city council of Mannheim, under authority conferred upon them by law, adopted additional regulations for certain details of yard and market management as follows, to date from February, 1900: (1) Certain places will be assigned to regular dealers for their usual occupancy according to their needs. (2) All yard and market fees must be promptly paid at the cashier's office by the person entering the animals, and the actual facts required for record regarding the latter must be given; receipts must be taken for fees paid, and these must be shown upon demand during the course of the market; upon sale of an animal or animals receipts for fees must pass to the buyer; these receipts must be shown and surrendered if an animal leaves the premises; animals will be held by the directory as security for all fees due; special provisions are made for animals arriving by rail or otherwise at hours when the office of the cashier is closed. (3) Payment of fees for most animals gives the right to hold them in the yard until sold; exceptions are lambs, kids, rabbits, fowls, and dogs, for which the market fee gives the right to remain only until close of the one market. (4) Animals held over night on the premises and sold again must pay another fee. (5) One fee for horses at the May Market holds good until noon of Saturday ending the week. (6) The directory is authorized and required to post placards giving the statistics of receipts, sales, and prices of animals from week to week, based upon actual transactions and records. (7) All weighings must be upon the public scales and by the regular weighers, and fees for same must be paid to the cashier in advance; certain hours for weighings are fixed from time to time by the director. (8) The director causes food and straw to be distributed upon demand of owners; the latter must pay for all so delivered, whether consumed or not; all forage and litter remaining unused belongs to the establishment; all such supplies must be paid for in advance or on delivery. (9) Owners are required to feed and water all animals while held at the market and yard at hours prescribed by the director; in cases of neglect the latter shall cause his employees to perform the service and the animals may be held as security for payment therefor. (10) All extra or unusual feeding, as to kind, quantity, and time, must be arranged for with the market master and fees paid to the cashier correspondingly. (11) All litter and manure belong to the stock yard. (12) All cattle brought onto the premises are insured against fire by the establishment, and fire losses will be paid pro rata from insurance collected; no responsibility is assumed for other damage or accidents, thefts, etc. (13) The officials and employees will give all possible assistance to owners gratuitously in cases of sickness and accident; in such cases the veterinary inspector is authorized to slaughter, in his discretion, but will avoid so doing so far as possible.

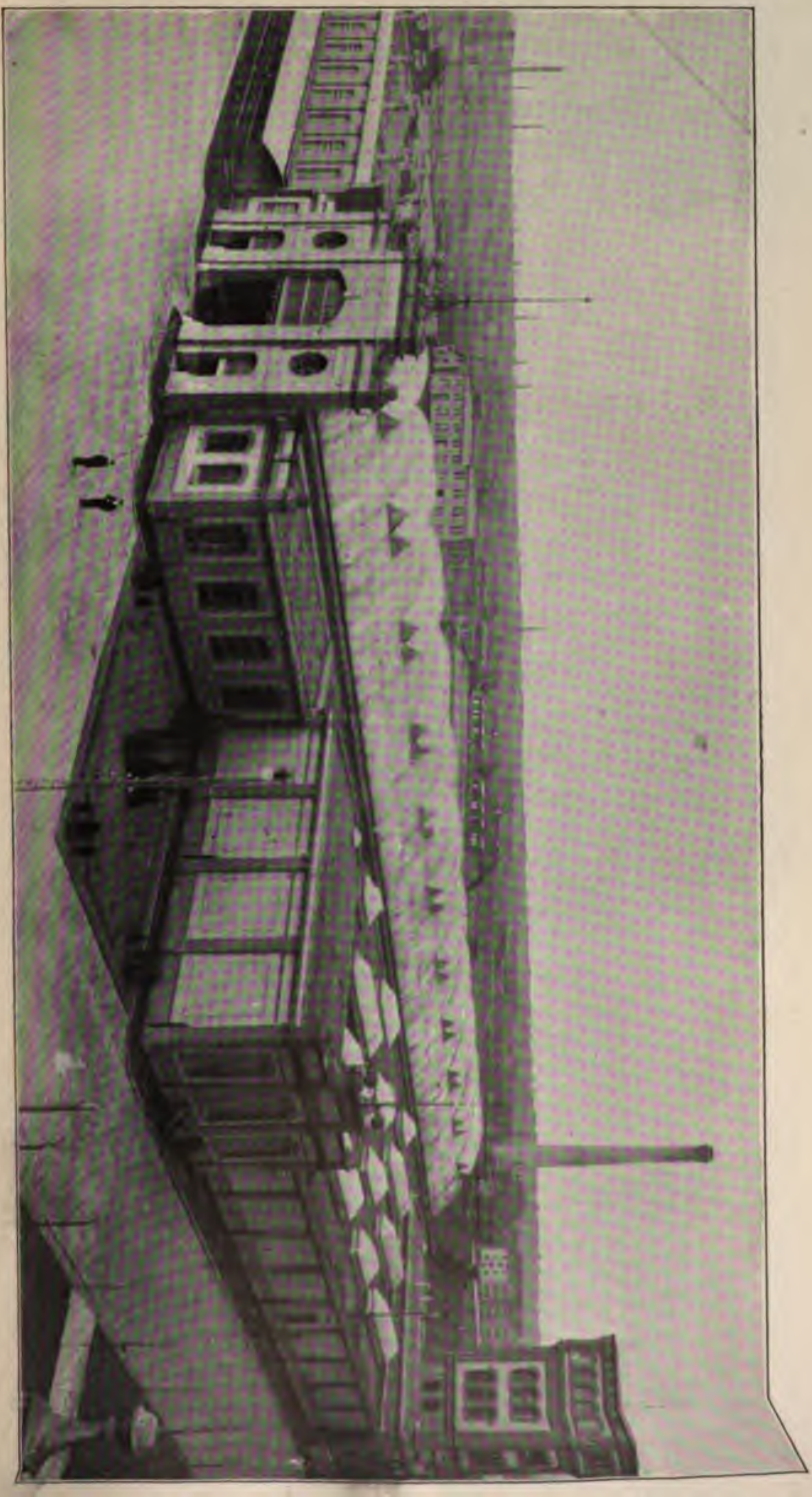
The terms of trading at the cattle market are also regulated by law or city ordinance, the chief provisions being as follows: All transactions must be completed at the Mannheim market, including payment; bargains can not be made there to be carried out elsewhere. Upon delivery of an animal to the buyer all fees and expenses from that moment and all risks pass to the buyer. The rule for all sales is cash payment; if not cash, and payment is deferred without agreed date, it is due at the opening of the next market day for like animals; if greater delay, agreed or otherwise, interest at 4 per cent begins eight days after sale for beef cattle and four weeks after sale for other animals. Custom requires "tips" or small gratuities to be paid at the time of sale, and these are in addition to and independent of the selling price and its payment; for all animals for slaughter the tips go to the seller; for horses not for slaughter the tips go to the employees of the seller. All horses and cattle when sold must have strong halters upon them, and payment for these is optional with the buyer. Sales by weight may be determined by the official weigher upon demand of either party. All animals sold without expressed guaranty are held by law to be so guaranteed, and if upon slaughter any are found diseased the seller may be held for all losses sustained by the buyer resulting from the postmortem sanitary inspection. The law also provides for a verbal agreement known as "half guaranty," pursuant to which buyer and seller share equally in any losses caused by the sanitary inspection of the carcass. Again, there may be a verbal agreement of sale without guaranty, in which case the seller is legally free from all claims. If animals are not slaughtered at once all guaranty expires fourteen days after a sale. A fresh, or new milch, cow is defined as one that has calved within six weeks prior to time of sale. If a cow is sold with guaranty to calve at a stated time, the law will not allow damage claims if the animal calves not more than one month before or after the specified date.

The regular fees and expenses of the stock yards and markets, all fixed by law, are as follows: (1) For entrance and general privileges of the ordinary market: Horses, beef cattle, and other large cattle, per head, 29 cents; all grown hogs, per head, 10 cents; calves, sheep, and goats, 5 cents; lambs, kids, and sucking pigs, 2½ cents. (2) For the special May Market (lasting five days): Horses in special boxes or reserved stalls, 97 cents; all other horses, milch cows, and breeding cattle, 48 cents per head; all other animals the same as for ordinary market. (3) For weighing, per head: Horses and large cattle, singly, 10 cents; for two or more at one time, and for a lot of several, half rate; for all small animals, 1¼ cents. There is also a fee of 5 cents for placing an animal in the visitors' stable, and fixed rates for leading or driving one or more animals between the market place and designated parts of the city, and for wagon loads of stock the same distances, including also transportation of this kind across the bridge to Ludwigshafen on the opposite bank of the Rhine. Fees are prescribed for sales at public auction—73 cents each for horses and large cattle and 24 cents each for smaller animals. Food furnished to animals detained in the yards is charged at current prices. Some quotations in May, 1900, follow, each for 100 pounds: Hay $1.10, straw 82 cents, oats $2.20, barley $2.20, wheat bran $1.32.

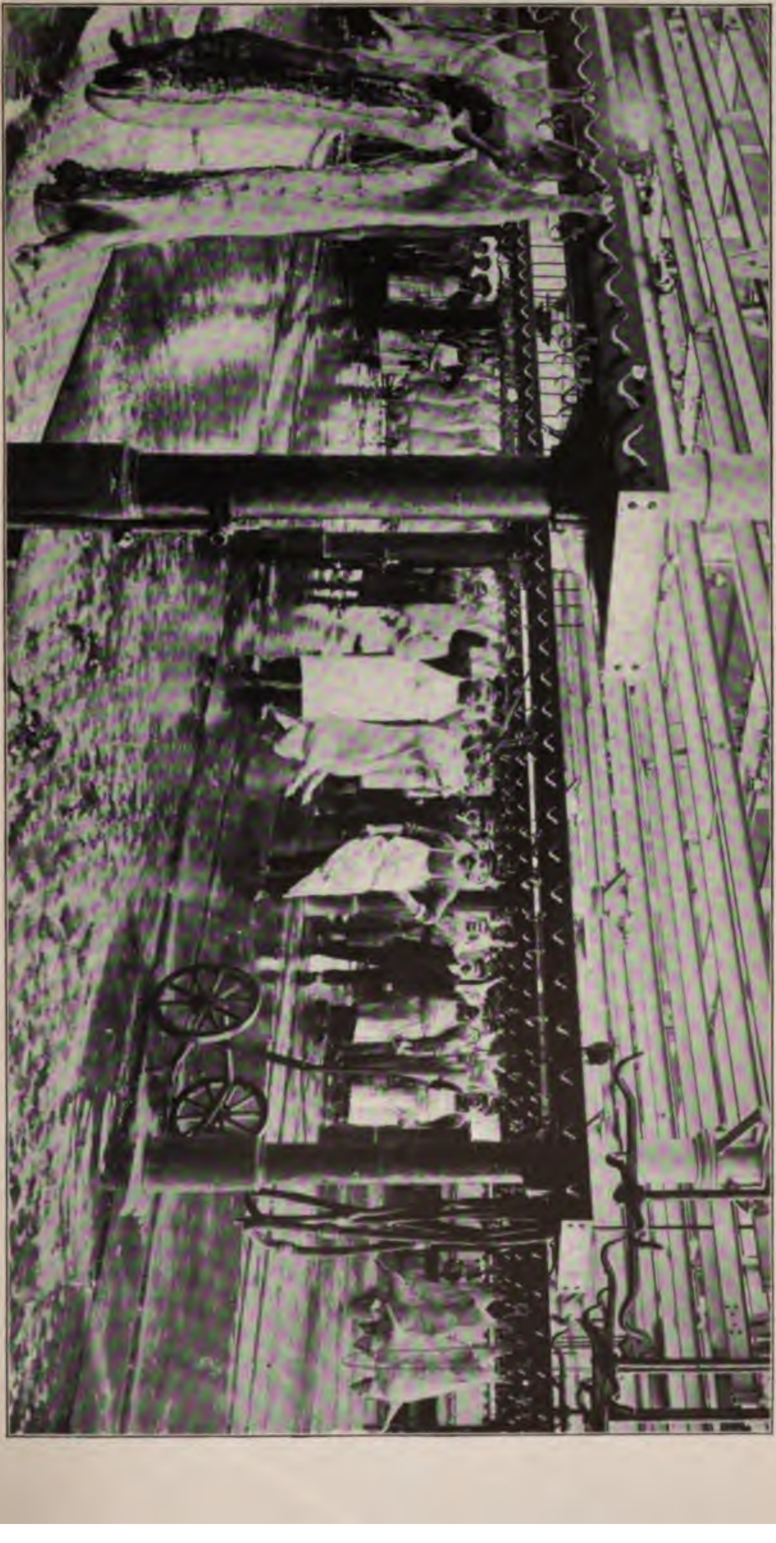
THE MANNHEIM ABATTOIR.

The half of the general inclosure described, west of the central dividing wall and apart from the occupation already indicated at the

PLATE XXI.

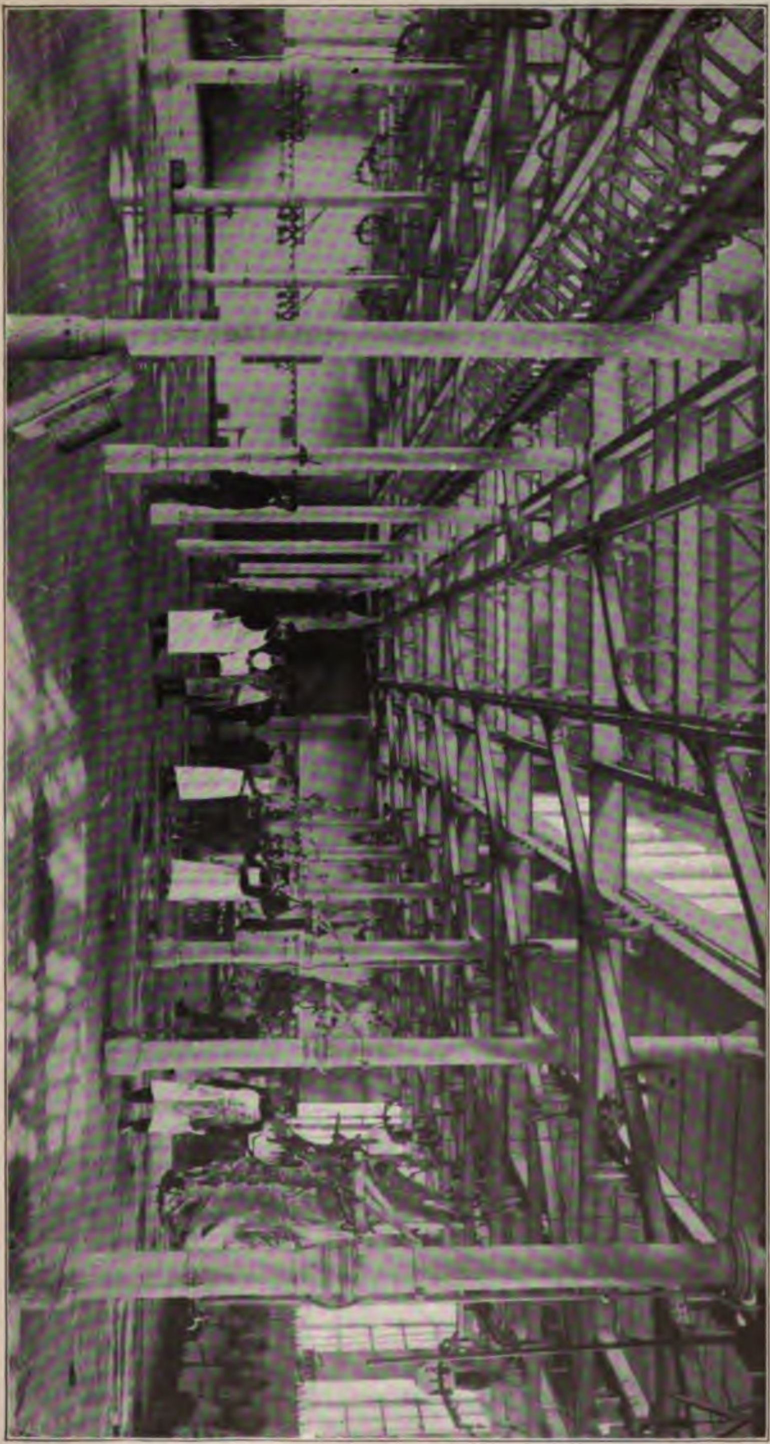


GENERAL VIEW OF THE ABATTOIR, MANNHEIM, GERMANY.



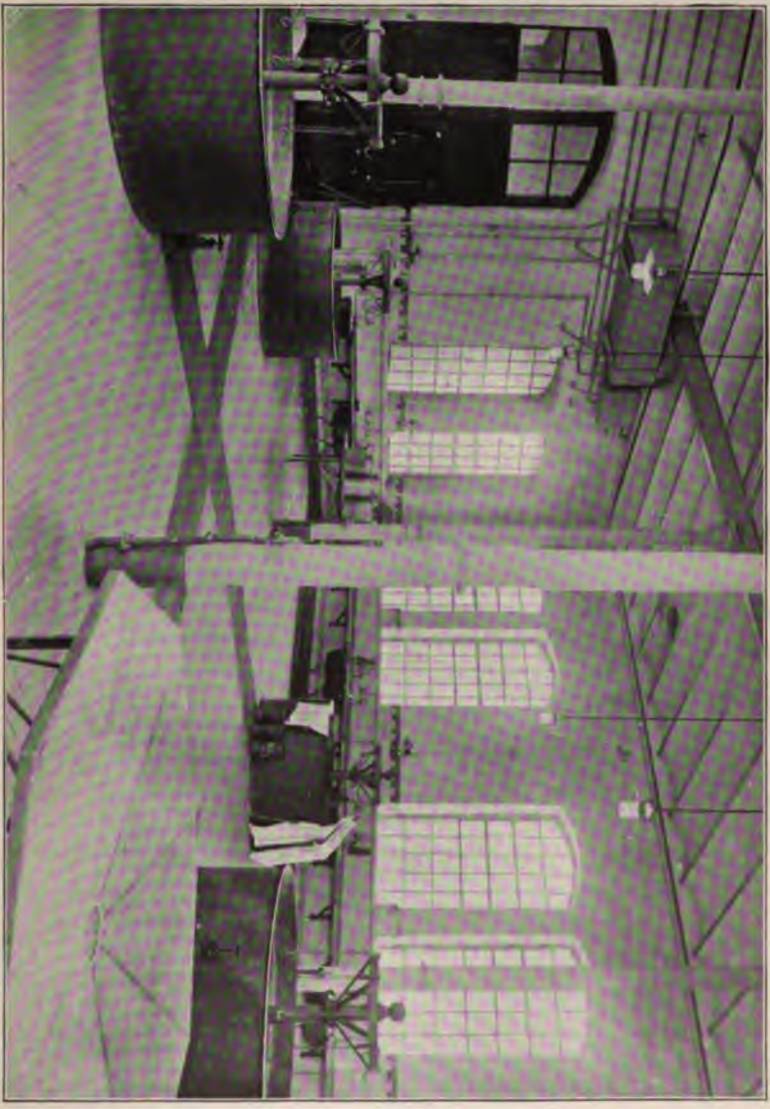
HALL FOR KILLING AND DRESSING HOGS AT MANNHEIM ABATTOIR.

Plate XXIII.



Interior of Slaughter Hall for Cattle at Mannheim Abattoir.

Plate XXIV.



Scalding Room for Entrails at Mannheim Abattoir.

ends next to the north and south outer walls, is assigned to the public abattoir and its various attachments. The main structure as already built is commodious and simple for present needs, but an almost equal area remains on the south not yet permanently occupied. This is now in grass and ornamental shrubbery. The illustration herewith (Pl. XXI) gives a fair idea of the general character of the building and something of its arrangement. The view is taken from the top of the administration building, looking to the southwest and diagonally across this group of connected departments constituting the abattoir. The entrances at the principal façade at the left are at the east end of an interior court 340 feet long, 60 feet wide, and 36 feet high, with a roof of iron and glass supported by twenty arches; the pavement is of compressed asphalt blocks. Passing along this court the killing halls for hogs, sheep, calves, and beef cattle are on the left, the first only being shown in the picture; on the right are the cooling halls and cold storerooms, the chopping sausage rooms, with pickling cellars in the basement; the cold halls are lighted from above, as shown in the view. Between the killing halls and the court are offices for the hall masters, cloak rooms, and toilet rooms. At the west end of the covered court are the power house, boiler room, and smokestack, and a little to the north stands the large square water tower.

The general arrangement is such that the killing halls are conveniently accessible from the rear and from the market spaces and sheds through the central gate in the division wall, and the small animals have to be moved the least distance. There is thus a direct and constant movement toward the northwest, until the butchers' meat and meat products reach the cold storage and other rooms in the front row of abattoir buildings, ready for delivery and transportation to retail markets.

The hall for slaughtering and dressing hogs is about 100 feet square (see Pl. XXII). There are pens along the outside for temporary detention and separate divisions inside for killing, scalding, singeing, scraping, and hanging for preliminary cooling. The calf and sheep halls are 50 feet square, with accommodations for slaughtering 250 animals at a time, and for hanging twice that number preparatory to moving to the cold stores. The slaughter hall for cattle is 130 feet long by 80 in width, divided by two rows of columns; the central part is 30 feet wide and the same height; the side sections are 20 feet high (see Pl. XXIII). A smaller and special building, somewhat removed, is fitted for killing horses, asses, and mules for food; more or less of this is constantly done. Another separate building on the west boundary is provided for the slaughter of all animals condemned while alive as being diseased and the carcasses of which have to be examined before deciding as to the disposition to be made of them.

These buildings, like all the rest, are of brick, stone, iron, and glass, of good appearance, substantial, and admirably adapted to their respective purposes. All are supplied with hot and cold water and live steam, electric light, and either steam or electric power, or both. The latter operate a great variety of mechanical labor-saving appliances, some quite novel. Hoisting apparatus is at hand wherever needed, so that manual lifting is almost wholly avoided, and, by suspended tramways, carcasses and heavy parts may be moved in all directions in the killing halls, and across the covered court to the chilling rooms. Artificial ventilation is also provided, so that every apartment may be supplied with currents of fresh air, dry, and either cold or warm, as may be desirable. The rooms for slaughter are large, light, and airy. Instead of little pens, as at Paris, in which butchers renting them do their own killing and handle different kinds of animals in one place, the arrangements at Mannheim are for a separate hall for every kind of animal, and a regular corps of licensed butchers employed by the establishment and working for all at fixed rates.

The butchering is humanely done, comparatively speaking. The large animals are killed by a percussion gun attached to the head with a mask, and the smaller ones are stunned by a blow on the head and then bled. Jewish slaughter is provided for by special regulations. Inspectors are present to supervise slaughter, and every quarter passed and approved for market is promptly branded. The owner's private mark is also attached. If upon opening an animal disease is discovered not before detected, and not so far advanced to make it necessary to condemn as food and destroy the carcass, the latter may be moved mechanically to a sterilizing room, conveniently located, and large enough to hold a whole horse or ox. There the carcass is sterilized, peculiarly branded, and it may then go to certain places for sale at low rates, under special and carefully executed police regulations.

Adjacent to the main abattoir are large accessory departments for rendering lard and tallow, preparing tripe, chopping meat, and making sausages in variety (see Pl. XXIV). All these rooms are supplied with labor-saving contrivances and all possible facilities for the work. Basement rooms contain provisions for dry salting and also a considerable number of brine tanks of several sizes, which are rented to different butchers. There are special provisions for salting hides preparatory to shipment.

The system of general drainage, subterranean conduits, and surface tramways is very complete. By these all blood and tankage are carried to suitable receptacles and offal and manure to appropriate places. The ample cleaning facilities are constantly employed, and these, in conjunction with the powerful ventilating fans, keep the entire establishment clean and odorless, except during the hours of most active operations.

The number of animals slaughtered at this abattoir during the year 1900 was reported as follows: Bulls, 1,028; oxen, 2,088; beef steers, 9,671; fat cows, 3,126; horses, 425; a total of 16,338 "large cattle;" the months having the largest business were October, July, and December. Calves, 21,006; hogs, 59,209; sheep, 2,782; lambs, goats, and kids, 668, a total of 83,665 "small cattle;" the months having the largest business in these animals, October, November, and August. This was a large increase over any previous year.

Animals found diseased and absolutely condemned as food were 96 cows, 6 other large cattle (including 2 horses), and 42 small animals, mainly hogs; three-fifths of all were tuberculous. Those somewhat affected by disease, but allowed to be sold as food under police regulations, numbered 273, as follows: 125 cows, 22 other large cattle, 99 hogs, and 27 calves. Thirty different diseases or causes for provisional condemnation were reported, two-fifths being cases of incipient tuberculosis.

As in the case of the stock yards and markets, general regulations are provided by law for the abattoir, and these are supplemented by the city council in matters of detail in management. The interesting features are condensed as follows: The slaughtering of all animals for human food, "excepting fowl and fish," in Mannheim and its suburbs must be done at the city abattoir; but in the suburbs an animal may be killed if its flesh is to be used exclusively in the household of the owner. This permission applies only to private families, and not to butchers, hotels, restaurants, prisons, and other institutions. The sanitary inspection of meat is done only at the abattoir, and there are heavy penalties for any sale or exchange of meat not so inspected. The abattoir is closed on Sundays and the principal holidays. On all other days it is open during hours announced by the management from time to time. At all seasons a bell signal is given at 5 p. m., after which there must be no killing. All employees must suspend work and be ready to leave the premises promptly at another signal an hour later. Fees must be paid in advance, and no animal is admitted to the inclosure for slaughter until the receipt for fees is presented at the gate. The same rule applies to animals brought directly to the abattoir and not from the market, the fees being somewhat different. As to these animals certain facts must be given when fees are paid, which are required for the statistical records. There are similar rules about paying fees in advance of the official weighing of animals or their carcasses. Animals taken to the abattoir must be handled in a careful and gentle manner. The same rules apply as in the stock yard. Single calves, sheep, and goats must be led by a rope. No animals are allowed to stand free or wander about the premises; all preparations must be made in advance, so that slaughter shall promptly follow arrival. Sheep or goats which give off a strong odor must be taken to the police (condemned-animal) slaughter hall for killing. Regulations prescribe specifically for the manner of killing animals of different classes, as already mentioned, and also for the exceptions and the special operations permitted, to conform to the Jewish ritual for slaughter. These all aim to guard against cruelty, injury, and rough handling. For example, all ropes for fastening, binding, or hoisting animals must be covered with leather; binding must be so secure as to prevent struggling and moving about, and breaking of horns must be avoided. Animals of different kinds may be slaughtered only in the appropriate halls and in the places and the sequence designated by the master of the halls. Licensed butchers only may kill. Apprentices may assist only and not work independently. Machinery and appliances may be operated only by those specially named for the purpose by the respective foremen. Blood to be used as human food must be collected separately from each animal in a clean vessel and stirred with a clean wooden spoon, never with the hand. Blood can not be removed from the hall until the animal from which it was taken has been passed upon favorably by the sanitary inspector. Until thus inspected completely and duly branded, no part of an animal may be taken away. Blood, bristles, etc., not claimed by owners of animals become the property of the abattoir. The intestines are not allowed to be opened in the slaughterhouses, but must be taken to a building specially designated, where they may be emptied and cleaned. No calf may be killed until at least two weeks old and showing eight incisor teeth. Aside from the vehicles of officials, only such conveyances are allowed to enter the abattoir grounds as are needed in connection with the work. There are designated places where such conveyances may go and may not. When in place the draft animals, whether horses, asses, or dogs, must be at once detached and placed in the appropriate stable. Except for draft purposes, dogs are not allowed on the grounds. Incoming and outgoing vehicles have to move slowly and in regular order, no passing of one another being permitted. Vehicles are also subject to inspection. They may enter the large covered court only upon certain conditions for the loading of meats to be removed. Persons other than employees and those having regular business, all of whom are supplied with tickets, must obtain written permits to visit any part of the abattoir, and there are certain parts requiring special permits, which are seldom given. A small fee is required from casual visitors. Children are not admitted under any circumstances. Expulsion from the ground at once follows any disorderly conduct on the premises or breach of regulations. The use of tobacco and liquor in the abattoir and its courts is forbidden. Rules as to the conduct of employees and those having periodical business at the place are numerous and explicit. In some places principals and employers are held responsible for the misconduct of agents and representatives. Cleanliness, order, and care of tools, implements, and fixtures are enjoined upon all. Offal is not allowed to accumulate, but must be removed from every animal to the several proper places before the next one is killed. No clothing or personal property must be left elsewhere than in the cloak rooms. And, as everywhere else in Germany, there are one hundred and one other things which are "*streng verboten*" (strongly forbidden). Provisions are made for correcting any faults or abuses and for appeal from the decisions of inspectors. The abattoir carries fire insurance upon its contents for the benefit of patrons, but disclaims all other responsibility for losses and damage.

The principal fees connected with this abattoir and its work, payable by the owner of the animal when presented for slaughter, are as follows: For the general privileges and services of the establishment, per head: Horse $1.45; beef animal, $1.35; hog, 40 cents; calf or sheep, 24 cents; goat, 12 cents; lamb, kid, or pig, 8 cents. For slaughtering only, per head: Large cattle, 73 cents; hog, 24 cents; small cattle, 12 cents. For weighing, per head: Large cattle, 24 cents; small cattle, 5 cents; a quarter of large animal, 6 cents. For scalding and cleaning head, feet, and intestines, per head: Large cattle, 10 cents; small cattle, 5 cents; for intestines only, large, 5 cents; small, 2½ cents. For inspection of animal or carcass, certification of partial disease, and permit to sell, per head: Horse or large cattle, $1.68; small cattle, 85 cents. For sterilization of carcass, in addition, according to weight: Large cattle, 400 to 800 pounds dressed weight, 73 cents; same, 200 to 400 pounds, 48 cents; same, under 200 pounds, or for a quarter or any part, 24 cents; hog, 24 cents; other small animal or part of same, 12 cents. For chopping meat and rendering fat or tallow, per 100 pounds, 50 to 60 cents, and fraction, pro rata.

Cold-storage charges have already been mentioned, and there are special fees for inspecting imported meats, fresh and salt, and additional for microscopical examination of imported pork.

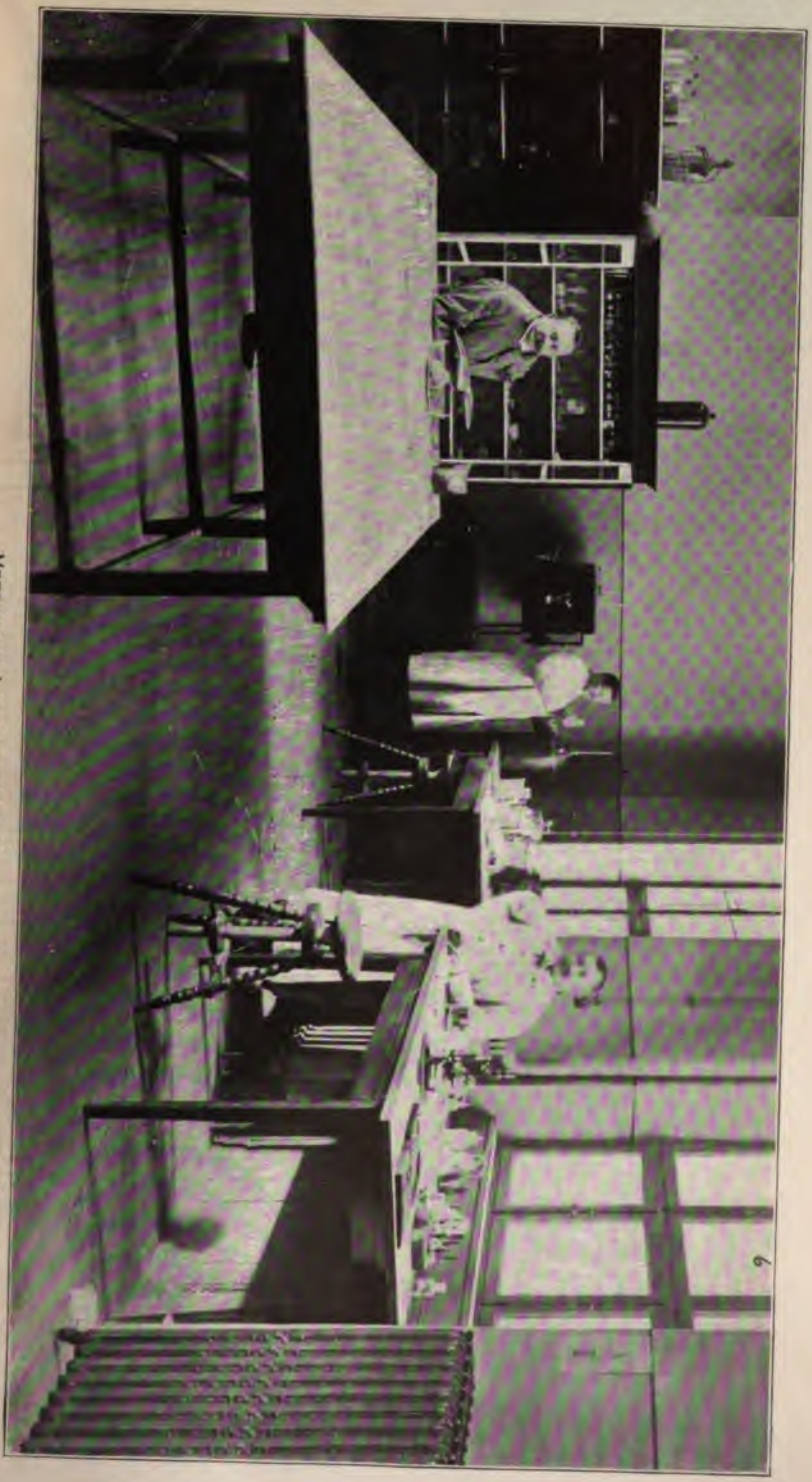
In an annex just at the right upon entering the covered court are large and well-lighted rooms for the biological and a chemical laboratory and quarters for the sanitary inspectors (see Pl. XXV). There are three veterinary inspectors regularly on duty. The rules for sanitary inspection are elaborate, minute, and severe, but too full of detail to be quoted.

THE COLD STORAGE.

All meat must remain in the abattoir where dressed or in the covered court until quite dry and cooled to the temperature of the outer air, or nearly so, before being admitted to the public cooling rooms. The cold halls, as already described and shown in the illustration, occupy a large building on the north front of the abattoir group. This is benefited by the shade of the high-arched roof of the court The general cold store is divided into three principal apartments—two preparatory halls at the ends, directly opposite the cattle and hog slaughterhouses, and the main hall in the middle. Dressed meats, hanging from elevated tramways. are moved mechanically across the court, protected in all weather, to the preparatory halls for large and small cattle, respectively. An interior view of the former is given in Plate XXVI. These rooms are at the disposal of all patrons of the abattoir, without additional fees, for a time (not exceeding twenty-four hours) sufficient to chill the meats. The temperature of these rooms is maintained at 43° to 46° F. All meat is expected to remain here till cooled to approximately the temperature of the room. It may remain longer upon special permit and payment of 24 cents per day for a large carcass or parts of same and half this fee for smaller animals. If not thus held, the day after slaughter it is either removed from the grounds, or, still hanging from tramways, it passes to the central hall, where it is distributed to the owners' individual cold boxes. In the event of exceptional crowding, the period of preliminary cooling may be shortened by the director. This main cold store is a hall 150 feet by 60, lighted from above, and divided into iron cages of two different sizes, not unlike cage cells in some penitentiaries. The larger size has a floor space of about 40 square feet and the others are about half that size. There are ninety of these cages of each size, and they are rented to meat merchants at $25 and $15 per year. For regular patrons of the abattoir the meats come under the control of the respective owners at these compartments for the first time after delivery of the animals for slaughter. When placed in the cages the latter are locked, the lessees hold the keys, and their meat is safe, cold stored, yet accessible to them or any authorized employee at all reasonable hours. The meats must not hang against the grating, but from hooks above, or be laid on benches well above the floor. It is thus disposed so as to be all subjected to currents of cold air and yet be out of reach; a leg of lamb could not be passed through the iron grating. A somewhat unsatisfactory view of a corridor in this hall is given in Plate XXVII. The cooling is by dry air, moved by powerful fans, cooled by passing over stacks of cold brine pipes prepared by the carbonic acid process. It is the intention to maintain the temperature of this hall throughout at 35° to 38° F., but no claim against the city (as owner of the plant) is recognized by reason of variation from these limits. After use in this central hall, the air passes to the two preparatory cooling halls on either side, and thence to the cooling apparatus, where it is dried, purified, recooled, and again put in circulation.

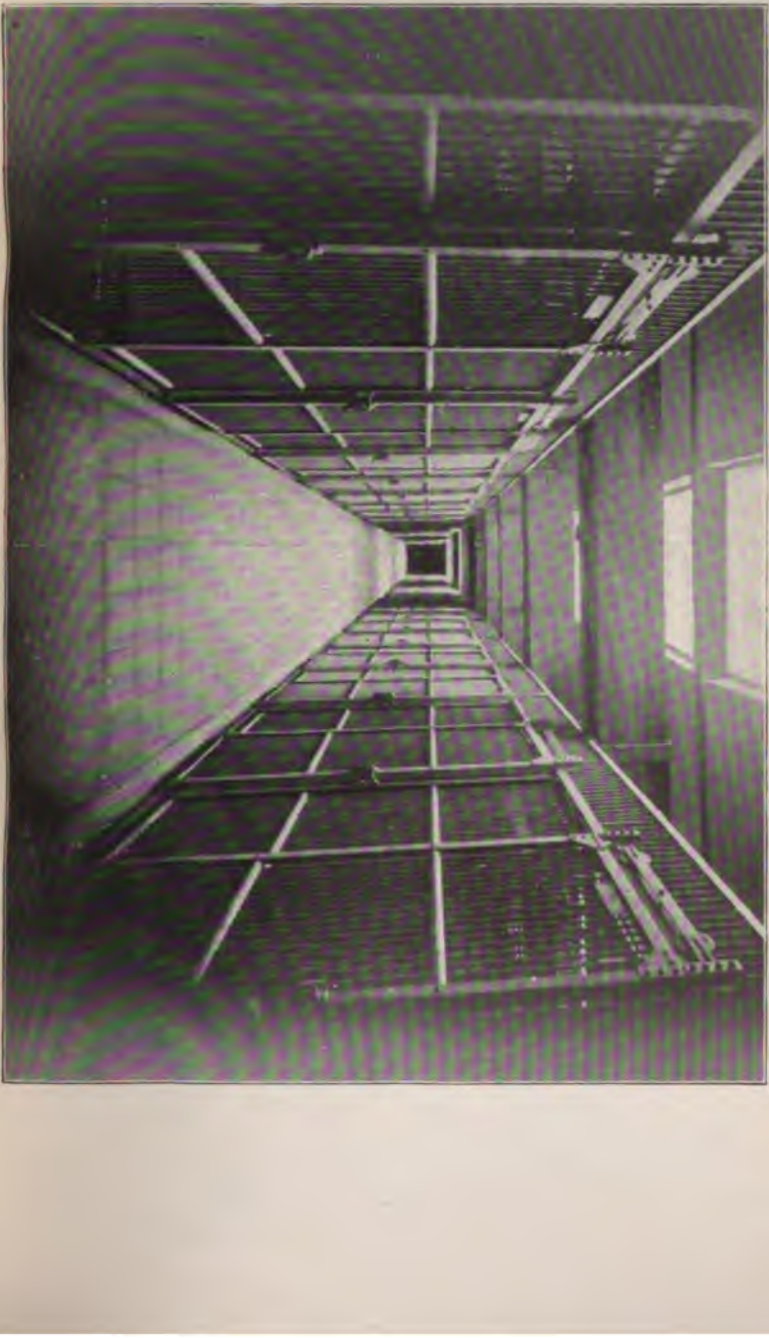
The cold-storage house for dressed meats is kept open for use throughout the year, but the actual artificial refrigeration season is begun and closed according to the weather. The cages are accessible during warm weather from 5 a. m. till 7 p. m. and for shorter hours in winter; on Sundays and holidays throughout the year the hours are from 5 to 9 o'clock in the morning. The rented cages or cold compartments may be marked with the names of the renters, but all such signs must conform to a prescribed size and pattern. Renters are

PLATE XXV.



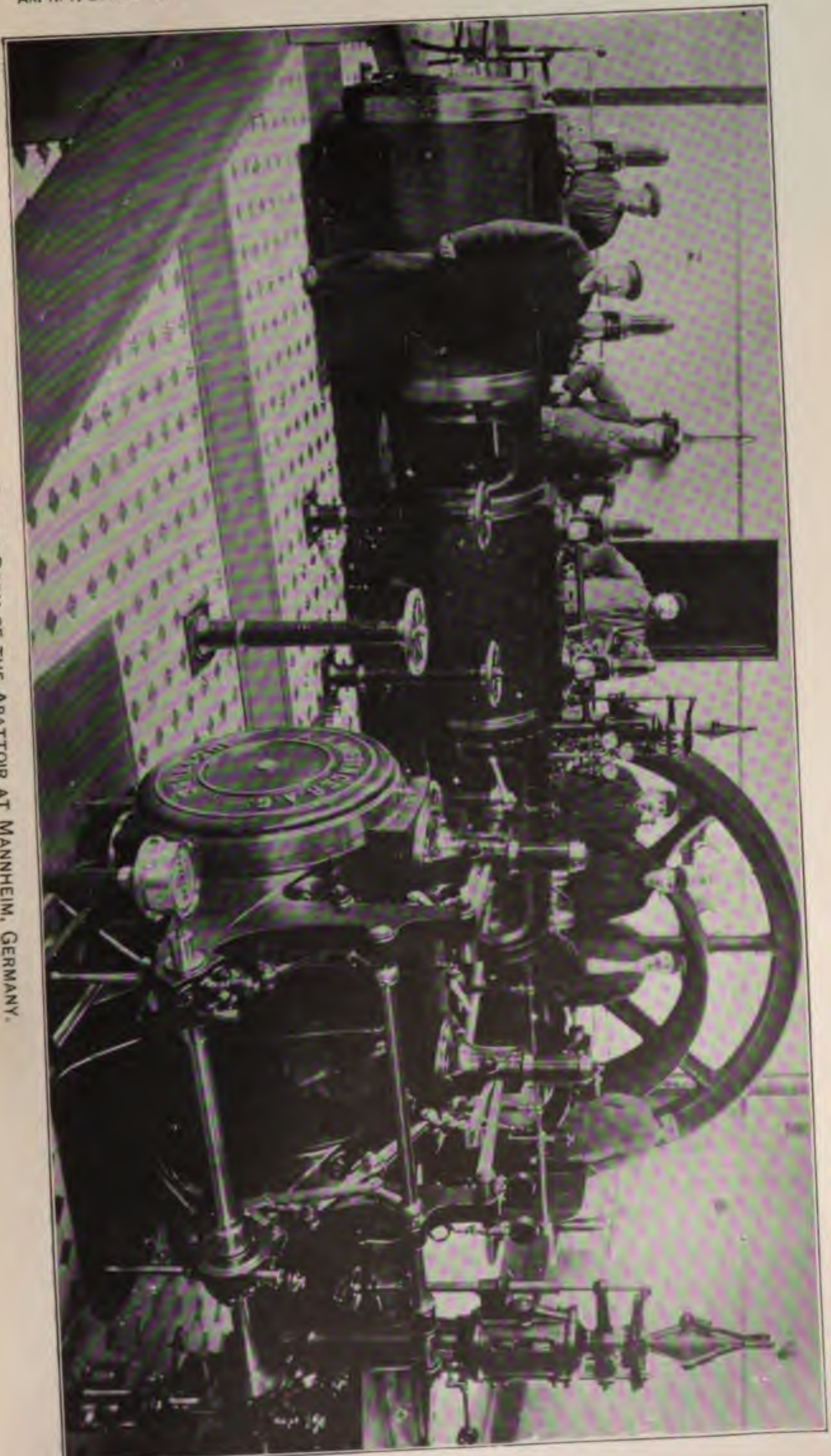
VETERINARY LABORATORY AT MANNHEIM ABATTOIR.

Cooling Room for Beef.



Interior View of Cold-storage Hall.

PLATE XXVIII.



ENGINE ROOM OF THE ABATTOIR AT MANNHEIM, GERMANY.

required to clean their compartments every Friday in a most thorough and painstaking manner, in accordance with specifications printed in detail; and cleaning must be done as much oftener as necessary to satisfy the warehouse inspector. Nothing is allowed in the rented cages except the meats entering them regularly from the cooling room. It is expressly forbidden to place or leave in these compartments tools, clothing, ropes, cloths, smoked or spiced meat (like sausage), or any offal or parts; and no salting or pickling is allowed therein. Meat which becomes old and musty or in the least tainted must be at once removed. Every renter is responsible for keeping his compartment closed, and no claim can be made for losses therefrom. The compartments and their contents are subject to be inspected at any time by the director and the abattoir inspectors, and renters must open them on demand for these officials. No transfer or subletting of the cold cages is permitted, except as regularly arranged through the general office.

The refrigerating machinery and ice-making plant are partly in the basement of the cold stalls and partly on the lower floor of the water tower (see Pl. XXVIII). The manufacture of ice, for use upon the premises, was as follows during the first nine months after operations began: April, 175,000 pounds; May, 390,000 pounds; June, 792,000 pounds; July, 1,090,000 pounds; August, 950,000 pounds; September, 745,000 pounds; October, 525,000 pounds; November, 100,000 pounds; December, 40,000 pounds; a total of 4,802,000 pounds, which was made in 88,000 blocks, weighing about 55 pounds each. Coal is used as fuel.

The management issues a book containing all the laws and regulations governing the entire establishment, with sets of detailed rules for almost every person employed on the premises, from cleaners and gate keepers, butchers and weighers, to foremen, or "masters," and the principal inspectors.

It was reported that during the year 1900 the flesh of 16,769 head of large cattle and 87,239 head of small cattle was prepared in this abattoir and consumed by the people of Mannheim and its suburbs. The total weight of butchers' meats was estimated at 23,760,000 pounds, which allowed a very little over 2 pounds per day for every family of five persons.

It is estimated that the stock yards and abattoir have at present a capacity to supply a population of 250,000, and, as already stated, that the establishment can be doubled in capacity, in all its parts, without change of general plan or interference with the harmony and convenience of the whole. The possibility is therefore undoubted of so expanding the facilities of this plant, within its present boundary, as to supply the wants of more than three times the population of Mannheim and vicinity at the opening of the twenty-first century.

THE DAIRY INDUSTRY AND DAIRY MARKETS OF PORTO RICO.

With Notes Upon St. Thomas and Cuba.

By R. A. Pearson, M. S.,
Assistant Chief of Dairy Division, Bureau of Animal Industry.

DAIRYING IN PORTO RICO.[a]

Dairying in Porto Rico has not advanced much from a primitive condition. Some persons hold to the idea that the industry can not be carried on in the Tropics, but the writer's observations lead him to believe that its present condition in Porto Rico is due to neglect rather than to insuperable difficulties, and that great improvements could be easily and profitably made. In this connection it is interesting to remember that only a few years ago it was supposed by many that the

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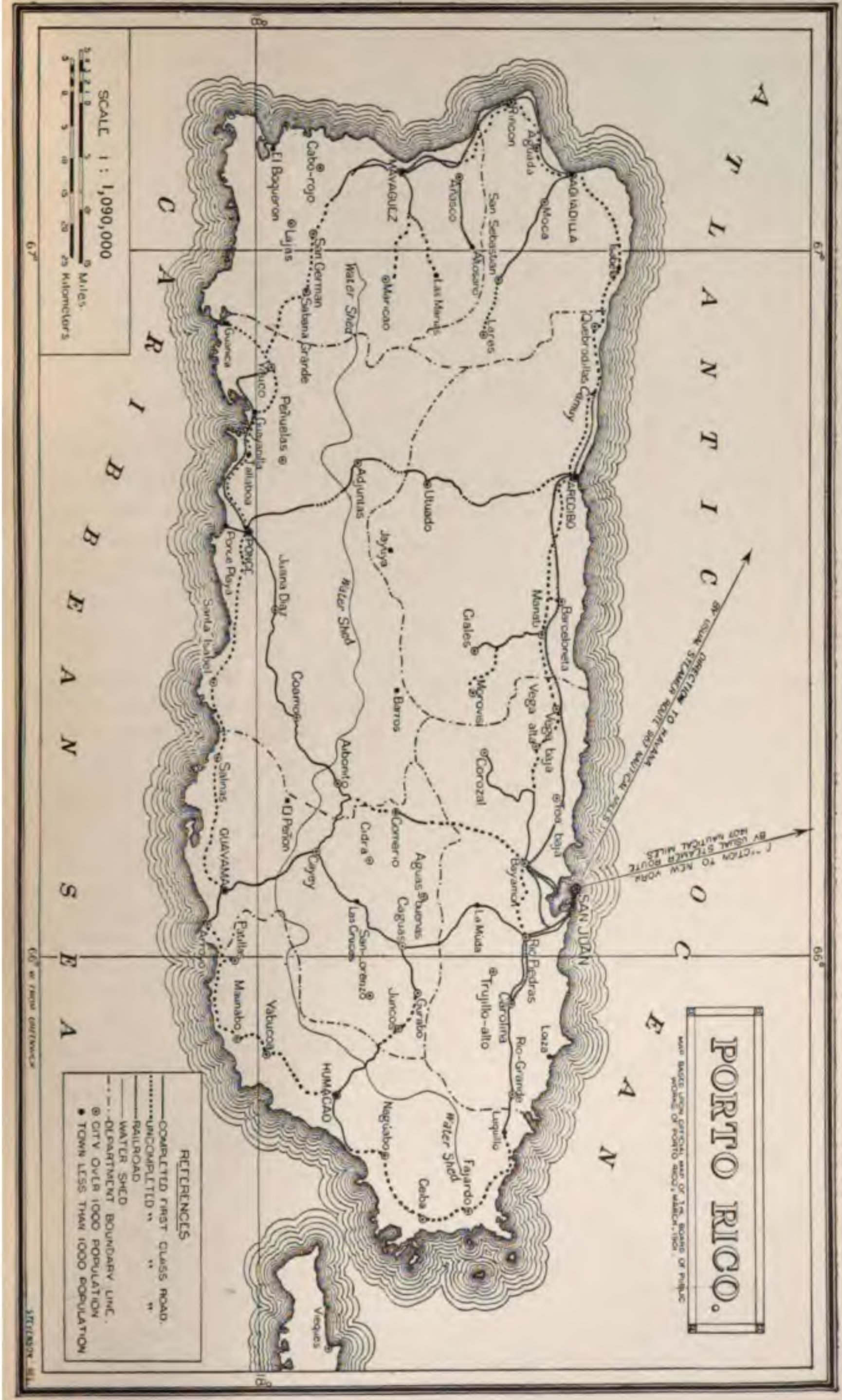
[a] *General information about Porto Rico* (Pl. XXIX).—Porto Rico is situated about 450 miles south and 900 miles east of the southernmost part of the mainland of Florida. It lies south and east from Cuba, the island of Haiti being between. It is nearly rectangular in outline, being about 100 miles long from east to west and 36 miles wide; its surface measurement is practically 3,600 square miles, or nearly the same as three-fourths the area of Connecticut. Although within the Tropics, the climate of Porto Rico is by no means intensely hot; the mean monthly temperature at San Juan ranges from 75° to 82° F., and highest and lowest temperatures recorded are 99° and 57° F., respectively. Over most of the island the rainfall is abundant, but in the southern part irrigation is depended upon more or less. A narrow strip of low land of varying width extends around the island, within which are ranges of hills and mountains, where many streams have their origin (Pl. XXX). There is great variation in the character of the soil, but, generally speaking, it may be said to be deep and rich. A very large portion of the island is under cultivation.

The census taken by the War Department in November, 1899, showed the large population of 953,243 (a little more than the population of West Virginia in 1900 and about the same density as that of New Jersey)—589,426 white and 363,817 colored. Only 21.4 per cent of the people live in the 57 cities having each a population of 1,000 or more. The common language is Spanish. English is but little understood. The principal occupation is agriculture, the leading products being sugar, cattle, coffee, and tobacco. The ten cities having a population of over 4,000 are:

San Juan	32, 048	Yauco	6, 108
Ponce	27, 952	Caguas	5, 450
Mayaguez	15, 187	Guayama	5, 334
Arecibo	8, 008	Manati	4, 494
Aguadilla	6, 425	Humacao	4, 428

The island has been in the possession of the United States since the autumn of 1898.


PORTO RICO.
MAP BASED UPON OFFICIAL MAP OF U.S. BOARD OF PUBLIC WORKS OF PORTO RICO, MARCH, 1901.
ATLANTIC OCEAN
CARIBBEAN SEA
SCALE 1 : 1,090,000
Miles.
Kilometers
REFERENCES
COMPLETED FIRST CLASS ROAD.
UNCOMPLETED " " "
RAILROAD
WATER SHED
DEPARTMENT BOUNDARY LINE.
⊙ CITY OVER 1000 POPULATION
● TOWN LESS THAN 1000 POPULATION
DIRECTION TO HAVANA BY USUAL STEAMER ROUTE 960 NAUTICAL MILES
DIRECTION TO NEW YORK BY USUAL STEAMER ROUTE 1407 NAUTICAL MILES
67°
66°
18°
W. FROM GREENWICH
SAN JUAN
Bayamon
Rio Piedras
Carolina
Loiza
Rio Grande
Luquillo
Fajardo
Ceiba
Naguabo
HUMACAO
Yabucoa
Maunabo
Patillas
Arroyo
GUAYAMA
Salinas
Santa Isabel
Ponce Playa
PONCE
Juana Diaz
Coamo
Aibonito
Barros
Cayey
El Peñon
Comerio
Cidra
Aguas Buenas
Caguas
Las Cruces
San Lorenzo
Juncos
Gurabo
Trujillo-alto
La Muda
Toa baja
Toa alta
Corozal
Vega baja
Vega alta
Morovis
Ciales
Manati
Barceloneta
ARECIBO
Utuado
Jayuya
Adjuntas
Tallaboa
Guayanilla
Peñuelas
Yauco
Guanica
Sabana Grande
San German
Lajas
Cabo-rojo
El Boqueron
MAYAGUEZ
Añasco
Rincon
Aguada
AGUADILLA
Moca
Isabela
Quebradillas
Camuy
Lares
San Sebastian
Rosario
Las Marias
Maricao
Water Shed
Vieques

establishment of dairying in the Southern States would never be possible; natural conditions were said to be prohibitory. But to-day many highly bred and profitable herds of milch cows are scattered throughout the "cotton belt," fine butter and cheese are produced, and the cow is coming to be looked upon as one of the chief agencies by which worn-out lands will again be made productive.

VALUES OF LAND.

The most fertile land on the island is a rich black loam near the coast, most of which is occupied by sugar plantations. The value of this land varies widely, being often more than $100 per acre. Coffee and tobacco are raised on cheaper lands in the interior—in the valleys and on the sides of the hills and mountains. Most of the cattle are found near the big sugar plantations. They are pastured on sugar land which is temporarily in grass, or on more or less elevated ground near the plantations, where grass is the perpetual crop. It was difficult to get accurate statements of values of these grass lands on account of the more or less unsettled conditions of trade at the time the visit was made, but it is safe to say that they usually vary from $25 to $50 per acre.

WATER SUPPLY.

Most of the island is well watered by rains, and there are many springs and streams which flow the entire year. In some sections, however, where fresh water is not available during short periods of the year, cattle do not flourish; sickness is said to result when stagnant water is used. The temperatures of water in springs, streams, and reservoirs were taken often (in April) and found to vary from 67° to 90° F. (table 1).

TABLE 1.—*Temperatures of water in springs, streams, and reservoirs in April.*

Source.	Time of day.	Temperature.
SPRINGS.		
Along the military road:		*° F.*
Near halfway house, between Cayey and Caguas	5 p. m.	73
Same, another day	Noon	74
About 5 miles south of Caguas	6 p. m.	74
Near Aibonita, toward San Juan (air 7 a. m., 73°)	9 a. m.	70
Near Aibonita, toward Ponce (air, 68°)	7 a. m.	67
Near Caguas	10 a. m.	78
Near San Juan	Noon	74
Elsewhere:		
Near Bayamon	9 a. m.	74
Near Manati (large flow)	6 p. m.	76
Same, another day	5 p. m.	75
Between Guayama and Cayey, in mountains	10 a. m.	69
Another, between Guayama and Cayey, in mountains	10 a. m.	70
Another, between Guayama and Cayey, in mountains	11 a. m.	72
Between Maunabo and Yabucoa (May 17)	6 p. m.	72
Between Guayama and Arroyo (May 18)	6 p. m.	80
Near Cayey	Noon	72

TABLE 1.—*Temperatures of water in springs, streams, and reservoirs in April*—Cont'd.

Source.	Time of day.	Temperature.
STREAMS.		° F.
Manati River (air, 84°)	2 p.m.	80
Near Coamo (air, 75°)	6 a.m.	76
Near Aibonita (air 7 a.m., 73°)	9 a.m.	73
Near Caguas	2 p.m.	90
Near Guayama	9 a.m.	70
Between Guayama and Cayey	10 a.m.	67
WELL AND CISTERN.		
Well near San Juan (about 6 feet to water)	6 p.m.	78
Cistern, highest point on road between Guayama and Cayey	10 a.m.	71

Temperatures in the morning are a little lower than in the evening, especially in the interior, where the nights are quite cool.

CATTLE FOODS.

There is not a large assortment of cattle foods produced in Porto Rico. One reason given for this is that during the Spanish régime the growing of most grains was prohibited or discouraged by the mother country in order to make markets for her own crops; but probably a more important reason is that the capabilities of the island along these lines have not been carefully studied. As there are now no unfair restrictions, and an experiment station has been established to investigate such questions, it will not be surprising to learn that as great a variety of fodder and grain crops can be produced as is found in many dairy districts elsewhere.

Corn is grown to some extent. It does best near the coast where the land is rich, but it is also raised on interior plantations. The stalks grow from 6 to 10 feet high under favorable conditions; ears 7 inches long are not uncommon. It is the same variety in all parts of the island, the kernels being light yellow in color and the cobs rather thick; the kernels are hard and are not injured by insects so readily as dent corn imported from the States. On the north coast corn does well if planted in May. It requires about ninety days for ripening, thus getting advantage of the rains, which can be depended upon in June, and the following short dry season. In the northwestern and southern sections of the island corn is commonly planted in August, during the latter part of the rainy season, and harvested in November or later.

The use of the corn stalk or leaves for fodder was not noticed. The grain is not generally fed to cattle or work horses, and only to a limited extent is it fed to driving horses of well-to-do people; most of it goes as human food. Considerable corn is brought from the States and, though its price should be only a little more than the price in New

York, together with transportation charges, it is sometimes much higher. Northern varieties of corn do not produce well, as they are not adapted to Porto Rican conditions.

Other grains are seldom seen. They are imported from the States in small quantities. As an example of the increase of cost of a cattle food when taken to Porto Rico from the States it may be said that a certain proprietary cattle food, which sells at $1.30 per hundred in New York, retails for $2.10 in San Juan. Oats cost about $2 per 100 pounds. Until late in July a small duty was collected on all feeding stuffs from the States, but this is now abolished.

Frequently plantains (a coarse variety of bananas) and sweet potatoes are fed to live stock.

Porto Rican cattle will not eat hay, as they have never been accustomed to it. Coarse green grass is available the entire year, and it is claimed that none other of the West Indies equals Porto Rico so far as this resource is concerned. Cattle or horses seldom receive any food other than grass.

"Malojillo" and Guinea grass are the varieties principally depended upon. Either of these becomes permanent after once being planted. The former flourishes on the low alluvial lands, especially where there is considerable moisture, and the latter is found chiefly in the higher and cooler districts of the interior. Malojillo pasture is considered by many to be better than any other; cattle upon it rapidly gain in weight. When a malojillo pasture runs down it may be renewed by tearing up the sod with a native plow or by the use of an English plow, so as not to turn the furrows completely. The grass quickly makes a fresh start. It is doubtful, however, if this grass is more nutritious than the Guinea grass, which is also extensively grown and claimed to be better than any other, especially for horses and for the production of a good quality of milk (Pl. XXXI).

There are numerous other native grasses which cattle depend upon more or less. One variety, called "matoja," is very coarse, grows chiefly in bunches on the hillsides and is not supposed to have a high food value. Another, called "joycatilla" (?), is a creeping grass which cattle like. It is said to do well on poor uplands and to withstand dry weather better than most others.

Leguminous plants are not grown for forage, and most of those found are weeds. Velvet beans and cowpeas have been introduced and, with care, produce good crops. They must be planted each year and cultivated once or twice. The cultivation introduces a serious objection for some localities, where hard rains wash the loose soils from the hillsides unless deep ditches are cut to prevent it. Velvet beans must be staked to prevent the pods from rotting on the ground. The seeds of cowpeas are eaten by the people and no use is made of the vines. Alfalfa and red clover have been tried, but have not yet been made to thrive. The beggar weed, or Florida clover, has been introduced and promises to do well.

Mr. O. F. Cook, special agent of the Division of Botany, who recently visited Porto Rico, has written as follows regarding the grasses:

> Grazing is not an industry to which many tropical countries are adapted, and certainly very few can compare with Porto Rico in this respect. The extremely tenacious clay soil favors the luxuriant growth of grass, and, if the woody vegetation be held in check, the pastures are permanent and perennial. There are numerous native grasses, some of which are said to afford fairly good forage, but none of them is cultivated, the two used in agriculture being the Guinea grass (yerba de Guinea), and the malojillo, or Para grass. The former is much more extensively planted, and is used in all places not too wet. In swampy meadows recourse is had to malojillo. The Guinea grass grows in bunches and sends up long stems to a length of 6 feet or more, although the leaves scarcely reach more than half that height. The malojillo is deeper green in color, decumbent at base, has very hairy joints, and the flower stalk has fewer and shorter branches. Both species produce luxuriant crops, but both seem too coarse to represent the food value of the same amount of the temperate grasses, though analysis of Guinea-grass hay has shown that the quality is good when cut at the right time.
>
> Some interesting experiments, designed to ascertain the yield and food value, have been reported recently from the Trinidad Botanic Gardens. Six cuttings were made on and between February 12 and December 9, with a total yield of 75 tons of green fodder per acre. This loses about 63 per cent in drying, leaving about 28 tons of hay, of which 33 per cent is woody and inedible, reducing the available dry fodder to 18½ tons, produced without manure or special preparation of soil. It is claimed that as many as 118 tons of grass per acre have been cut from rich land, or nearly 7 pounds per square foot. Analysis of this crop shows albuminous compounds slightly in excess of those of clover hay, but the carbonaceous and fibrous material is given as about 20 per cent less.
>
> The continuous growth and enormous production render the Guinea grass the most advantageous fodder crop in spite of this deficiency. If it could be supplemented by some equally good leguminous plant, the conditions for stock raising would leave little to be desired. That its quality and wholesomeness must be of the best is evidenced by the fact that horses and cattle thrive and work on an unvarying and unsupplemented diet of green fodder. What results would follow from the use of a properly developed and balanced ration can only be conjectured.
>
> Cattle partly hidden in the tall Guinea grass are no uncommon sight in luxuriant Porto Rican pastures, which could scarcely be duplicated in the United States. Throughout the entire island a large part of the land is given up to grazing which, on account of the recent depression in the markets for the local agricultural products, has received great impetus as the safest and most profitable business in which the farmer could, for the present, engage.

CATTLE.

Cattle are raised in Porto Rico for three purposes—work, meat, and milk. The industry is one of the most important on the island, and it is said to be one of the oldest. The census taken by the War Department in 1899 reported a total of over 260,000 horned cattle—more than the number of neat cattle on farms in Massachusetts in 1890 (table 2).

FIG. 1.—INTERIOR LANDSCAPE.

Military road on the hillsides.

FIG. 2.—LANDSCAPE NEAR CAGUAS.

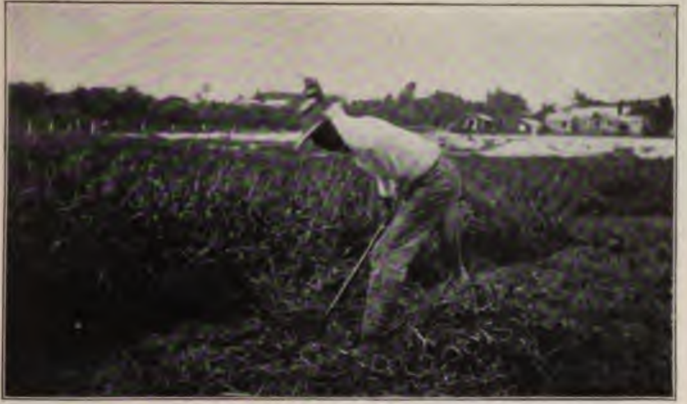


FIG. 1.—CUTTING GRASS FOR COWS.
The long machete held in left hand was moving too rapidly to be photographed.

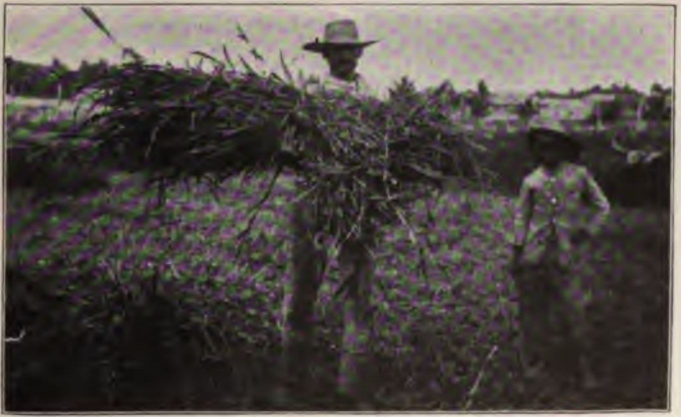


FIG. 2.—A BUNDLE OF NATIVE GRASS.
The quantity usually sold for 5 cents.

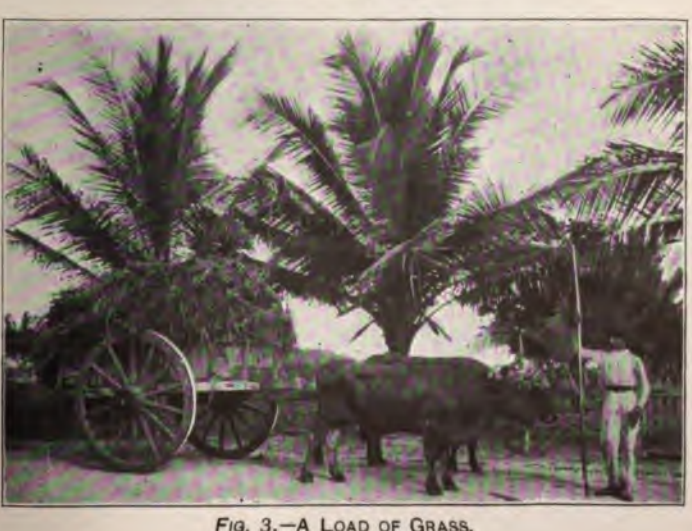


FIG. 3.—A LOAD OF GRASS.

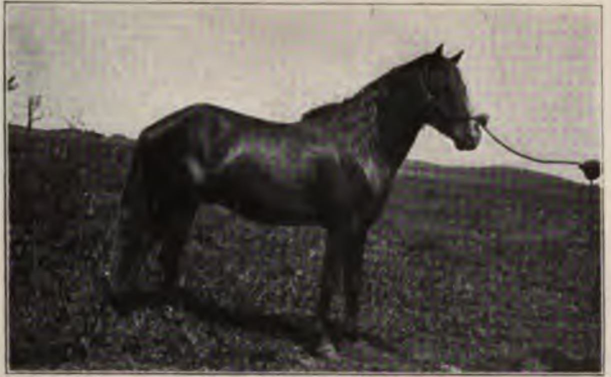


FIG. 1.—NATIVE HORSE.

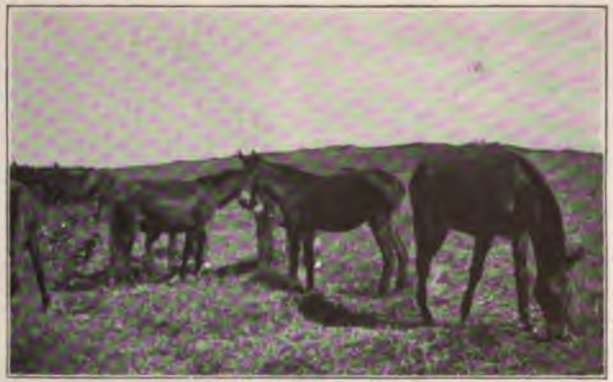


FIG. 2.—NATIVE MULES.
Sired by a Spanish jack.

TABLE 2.—*Number of horned cattle in Porto Rico.*

TOTAL ON THE ISLAND.

Departments.	Bulls.	Cows.	Oxen.	Steers.	Yearlings.	Young bulls.	Heifers.	Calves.
Aguadilla	667	5,311	4,846	374	2,363	267	2,109	1,366
Arecibo	764	8,760	6,424	856	4,623	820	3,566	3,041
Bayamon	1,477	17,215	9,905	1,841	7,495	6,037	7,368	6,661
Guayama	814	12,559	8,646	1,109	6,709	3,691	5,645	4,422
Humacao	908	12,492	9,773	1,197	6,234	8,027	5,466	4,917
Mayaguez	835	8,085	7,264	1,255	3,326	704	3,892	4,125
Ponce	802	8,950	11,015	978	3,572	2,483	3,120	3,054
Total	6,267	73,372	57,873	7,610	34,322	22,029	31,166	27,586

ON FARMS.

Departments.	Bulls.	Cows.	Oxen.	Steers.	Yearlings.	Young bulls.	Heifers.	Calves.
Aguadilla	641	5,091	4,747	366	2,261	254	2,046	1,311
Arecibo	611	7,610	5,651	644	3,999	543	2,836	2,478
Bayamon	1.139	12,825	8,409	1,198	5,421	4,460	6,004	5,191
Guayama	608	9,641	6,935	700	4,868	1,815	4,344	3,182
Humacao	734	8,550	8,419	908	4,423	3,510	3,582	3,053
Mayaguez	714	6,923	6,657	1,129	2,954	667	3,455	3,730
Ponce	518	6,483	9,380	644	2,869	1,011	2,268	2,102
Total	4,965	57,123	50,198	5,589	26,795	12,260	24,535	21,047

NOT ON FARMS.

Departments.	Bulls.	Cows.	Oxen.	Steers.	Yearlings.	Young bulls.	Heifers.	Calves.
Aguadilla	26	220	99	8	102	13	63	55
Arecibo	153	1,150	773	212	624	277	730	563
Bayamon	338	4,390	1,496	643	2,074	1,577	1,364	1,470
Guayama	206	2,918	1,711	409	1,841	1,876	1,301	1,240
Humacao	174	3,942	1,354	289	1,811	4,517	1,884	1,864
Mayaguez	121	1,162	607	126	372	37	437	395
Ponce	284	2,467	1,635	334	703	1,472	852	952
Total	1,302	16,249	7,675	2,021	7,527	9,769	6,631	6,539

It is shown by the table that the cattle industry is of importance in all parts of the island. As a rule, the small farmer has one or two cows and perhaps an ox or a yoke of oxen. But most cattle are seen in localities where large numbers are needed for working—in the vicinity of the sugar plantations, on which they are used for plowing and hauling cane, and near the military roads, over which a large amount of freight is carried in ox carts. The large number of oxen does not seem unreasonable when it is known that they do practically all of the heavy hauling both in country and town. Bulls are used for draft purposes to a small extent; cows are not thus used. Horses and mules[a] (Pl. XXXII, figs. 1 and 2) are seldom seen except when drawing mortem to be diseased, I conclude that there is but a small percentage of these cattle affected with tuberculosis. The bacilli of tetanus and blackleg have a general distribution. Deaths from these diseases occur annually in different parts of the island. Minor surgical operations have been so frequently followed by tetanus that the use of the knife in castration has been discarded, and, as prevention against invasion by germs and annoyance by flies, a rather imperfect form of castration is accomplished, either by bruising the testicles or by rupturing the spermatic cord by torsion and tension without incising the skin.

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[a] The 1899 census reported 58,664 horses, 6,985 mules, and 1,085 asses. (A few sheep are on the island and many hogs [Pl. XXXII, figs. 3 and 4].)

From the reports of cattle owners it appears that exceptional conditions on this island produce annually a few well-marked cases of Texas fever. Ticks are the greatest enemies of these cattle. In all localities they were found infested with ticks, always apparently of the same species. If it is proven that this tick is capable of transmitting Texas fever, there can be no doubt that all Porto Rico teems with the contagion of Texas fever throughout the entire year, and that no cattle could depart from or be brought into the island without contact with such contagion.[a]

MANAGEMENT OF STOCK.

Cattle in Porto Rico receive little special care. As a rule, shelter is considered unnecessary except for young calves, for which a thatch roof supported by posts suffices (Pl. XLII). This "building" has no sides or floor, but one end of the space is sometimes inclosed for a pigpen or perhaps for living quarters. In any month herds may be seen grazing on the hillsides or scattered and tethered in the heavy grass. Green grass is the only feed used, and that it is of good quality is shown by the excellent appearance of the stock. Calves are seldom slaughtered.

METHODS FOLLOWED ON DAIRY FARMS.

The methods followed on farms where milk is an important product can best be made known by describing in some detail the operations of a few of the places visited. Any American dairyman who could see Porto Rican dairies would meet with many surprises, and would find numerous places where changes might be made to decided advantage. The methods are primitive and capable of great improvement.

Several hundred fine-looking cattle were seen on an estate of 2,500 acres on the north side of the island (Pl. LIII, fig. 1). This property belongs to a wealthy gentleman who had been engaged in the sugar business, and, though his land was well adapted for raising cane, most of it had been changed to pasture. For several years some care has been taken to select for breeding purposes only the largest bulls having a light yellow or reddish color, and the result of this selection of sires is very apparent. The stock presents a uniform appearance and averages a little heavier than common. One bull, said to be a purebred Durham, whose sire and dam came from England, has had a distinct influence on the offspring (Pl. XLIII). In connection with the

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[a] Recent investigations by this Bureau have shown that Texas fever is prevalent in Porto Rico.—R. A. P.

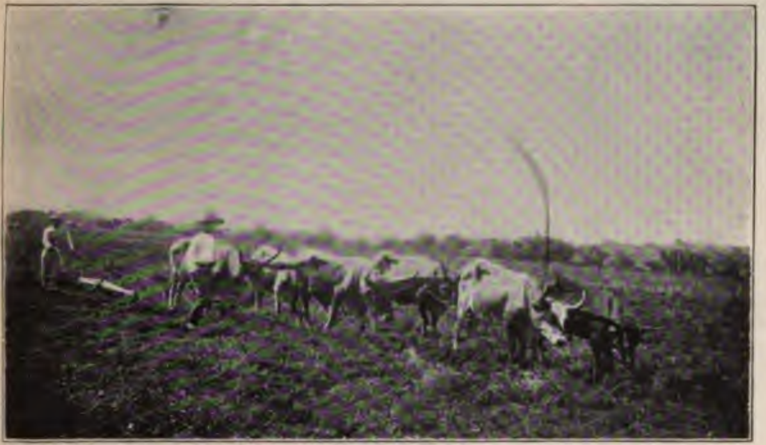


FIG. 1.—PLOWING WITH OXEN.

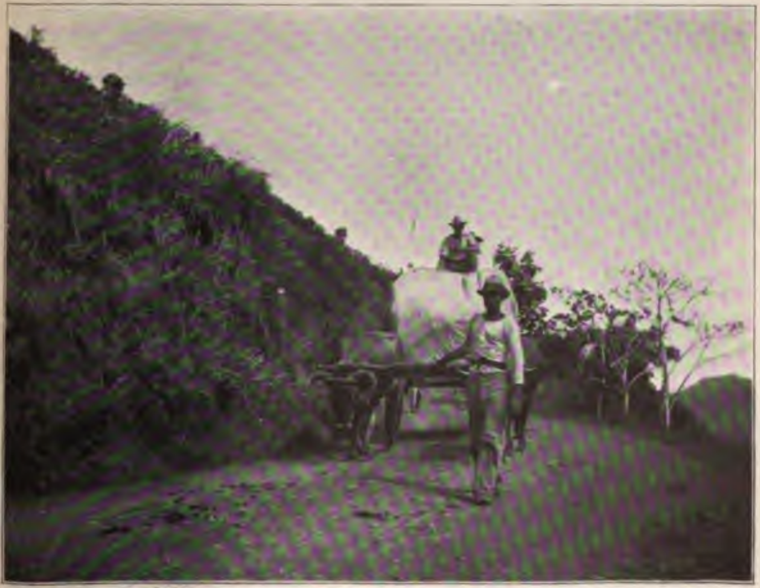


FIG. 2.—OXEN AND LOADED CART.
On the military road.

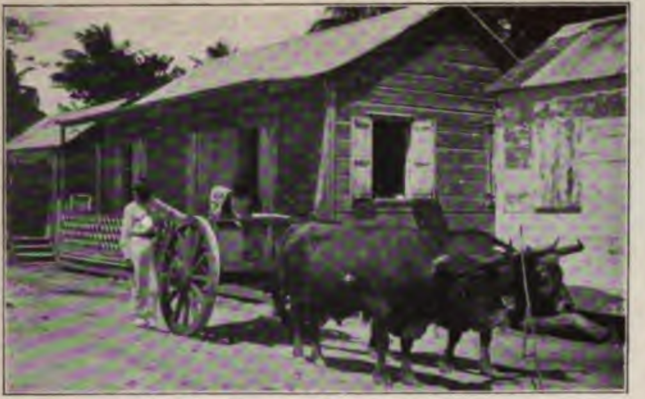


FIG. 1.—YOKE OF OXEN AND CART.

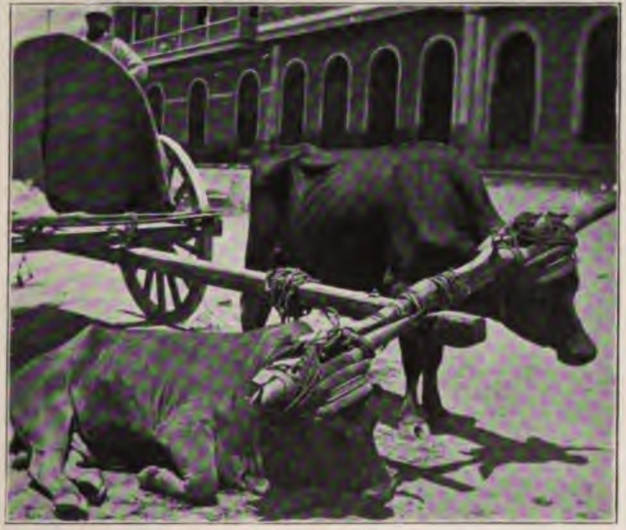


FIG. 2.—YOKE OF OXEN.
Showing method of attaching yoke.

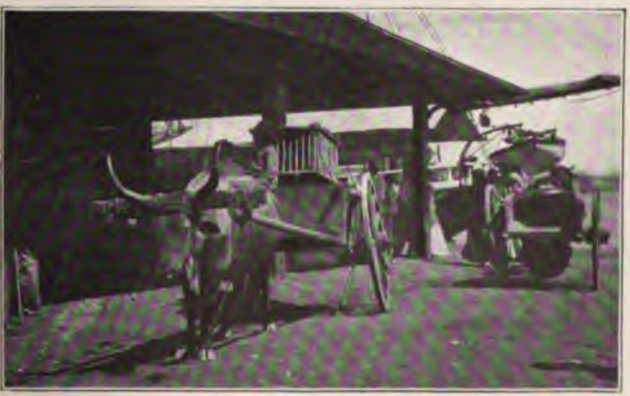


FIG. 3.—OX AND CART.

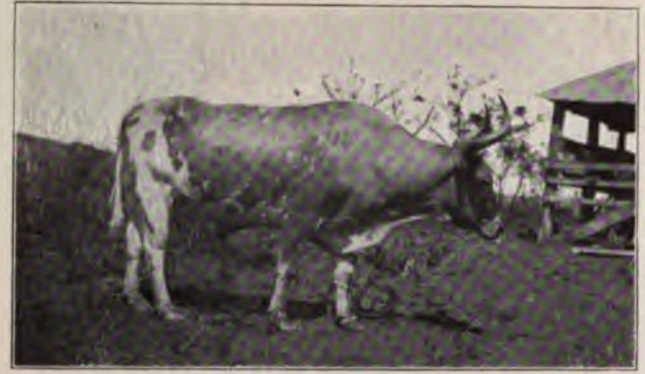


FIG. 1.—NATIVE OX.

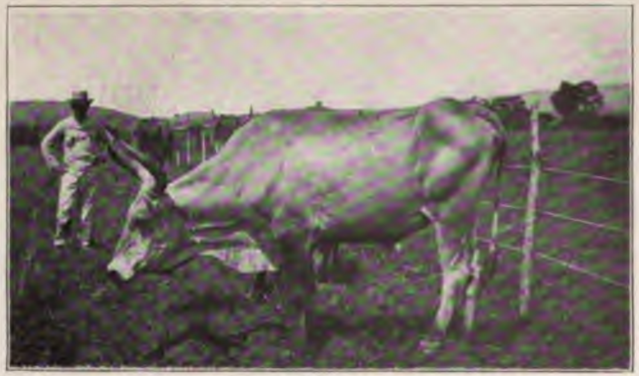
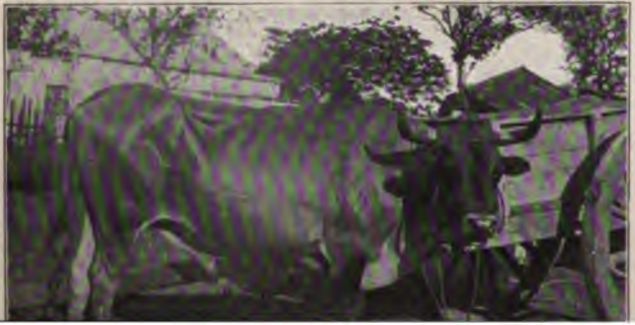
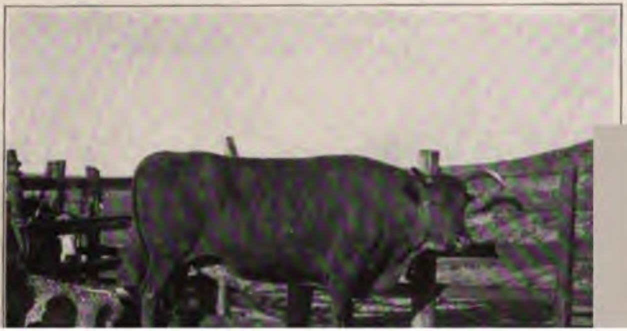


FIG. 2.—NATIVE OX.





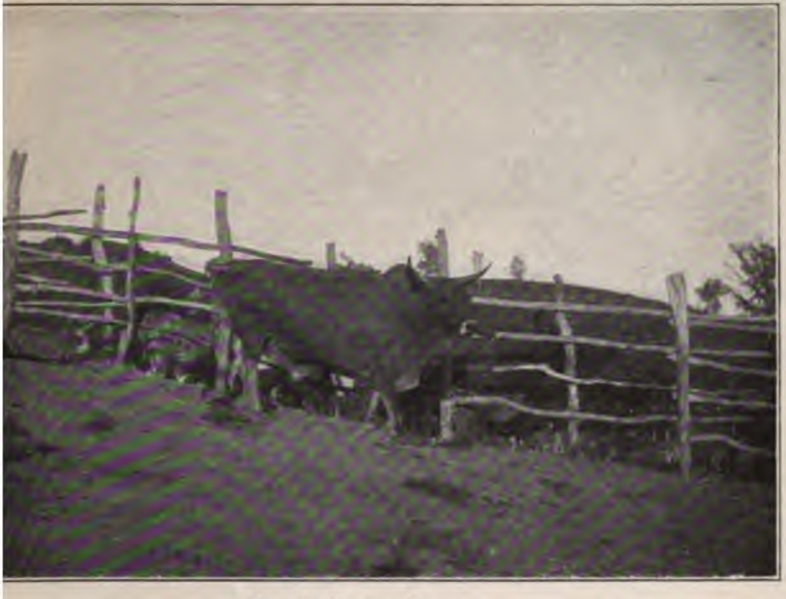


FIG. 1.—NATIVE BULL.
Showing influence of African importation.

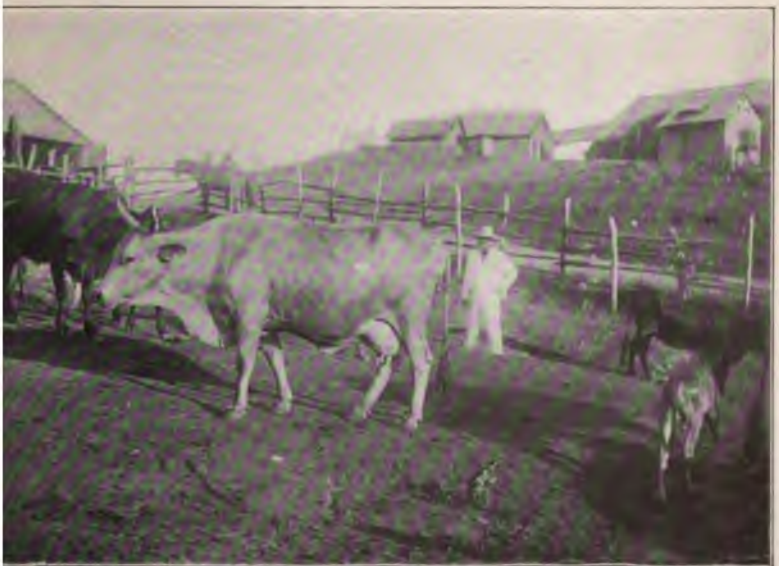


FIG. 2.—A SUPERIOR NATIVE MILCH COW.

preference for light yellow and red colors, as stated, it may be added that black animals are supposed to suffer the most from heat.

On this estate there is a herd of nearly 200 cows; bulls are always with them, and the herd increase is quite regular from month to month. Calves run with their dams until nearly a year old and they take a portion of the milk each day as long as it lasts, which is usually from five to seven months. The young stock is then pastured all together until about 18 months old, when males and females are separated, the former to be sold when about 3 years old. There were about 150 fine-looking steers between 2 and 3 years old, and averaging close to 1,000 pounds. Most of these were soon to be exported to Cuba, where they would be used as working cattle.

Cows are kept for their increase; the milk which is taken for household or commercial purposes is considered of incidental value only. Many of them are kept until eight or ten years old, when they are turned over to the butcher. As is the almost universal practice, the cows are milked only once a day, the calf always being on hand to help "start" the milk. After milking, the cows and calves go to pasture and remain together until afternoon, when the calves are separated. If they are quite young they remain with the cows until late in the day, but after a few months old they are taken away early in the afternoon. At dusk the cows are brought to a yard near the milking shed, where they are kept all night.

The operation of milking is most crude. It is usually done early in the morning. The hind legs of each cow are first tied together with a short piece of strong rope to prevent kicking. The rope is necessary in some cases, though very often it is useless, as many cows remain perfectly quiet. Each calf is near its mother, but not allowed to take any milk until it is her turn to be milked. When that time comes the calf's appetite is well stimulated by the long fast and by the short time the breakfast has been almost, but not quite, within reach. The milker releases the calf, allows it to draw a little from each teat, simply to start it, then puts the calf out of the way, and draws into a pail what he considers about three-fourths of the milk in the udder. The calf is then allowed to have the rest. Sometimes the milker takes all the milk he can get from three teats, leaving the fourth for the calf, which is a much better division. If the milker does not succeed in getting as much milk as he thinks he should have, the calf is allowed to "start" it a second time. As soon as the milker is through, the rope used to prevent kicking is removed, and the cow and calf are ready to go to pasture. The yield per cow varies from 1 pint to more than 6 quarts.

Some herds are kept near cities and towns for the special purpose of producing milk, and the largest of these, as well as the one supposed to be the best managed, is located 6 miles from San Juan. It has 200 gent selection, breeding, rearing, and management, develop much better milkers in the course of a few years. Better management would include, first of all, different treatment of the calves. The present practice, as has been shown, is to allow the calves to be with their mothers a few hours after each milking, then separate them, and give them nothing, or almost nothing, until after the cow has been partially milked the next day, when the calves are allowed to take all they can get, and this is usually the "strippings." It is not strange that a large number of calves die. At one dairy it was said about half the calves die within a few months after birth. They gave appearance of being a badly starved lot, and it is probable very little milk was left for them (Pl. XL, fig. 3). If the system of feeding calves was objected to for no other reason, it may be severely criticised because there is no way of knowing how much the calf gets. A milker who attempts to leave one-quarter of the milk may leave twice or half that amount; he has no way of measuring the quantity.

The belief that it is absolutely necessary for calves to remain with the cows is almost universal. The fact that when a calf is lost the cow is liable to soon go dry is taken as proof positive that the calf can not be dispensed with. A few cow owners who had seen or learned a little about modern dairy methods believed cows might be trained to give milk without having their calves beside them, but an actual experiment was not heard of. It would probably be as difficult to teach most cow owners as the cows that it is best to remove the calves immediately or within 2 or 3 days after they are born and raise them on skimmed milk and meal, milking the mother regularly twice each day. After practicing the "natural method" many generations, an innovation of this kind might be made only with difficulty.

CATTLE FROM THE STATES.

Undoubtedly the quickest and most satisfactory way to obtain a herd of good milch cows in Porto Rico would be to take them there from the States, where, for a reasonable price, cows can be had that will give an average of 10 quarts of rich milk daily for 10 or 11 months each year—cows that are trained to give all their milk to the milker and not a large part of it to the calf. But it would be useless for anyone who does not understand modern dairy methods to possess such stock, as it would quickly deteriorate in his hands. The importation of only a few animals might form the basis of a large and profitable herd. If crossed on the best natives, an excellent strain might thus result. Knowledge of modern methods is the thing of first importance; after that the introduction of high-grade stock.

A natural question in this connection is, Which dairy breed would do best in Porto Rico? Experiments that might throw light on this question have not been made. In this case, as in the selection of ani-

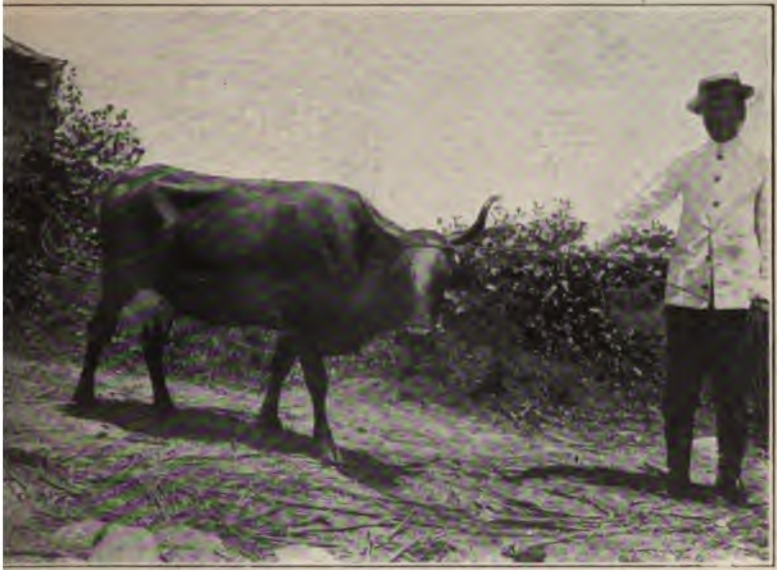


FIG. 1.—A SUPERIOR MILCH COW NEAR MANATI.

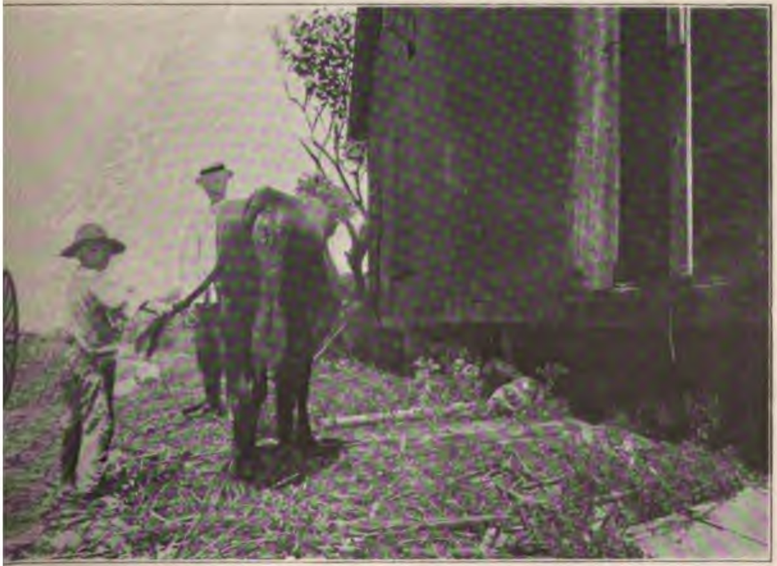


FIG. 2.—SAME (REAR VIEW) AND CALF.

PLATE XXXVIII.

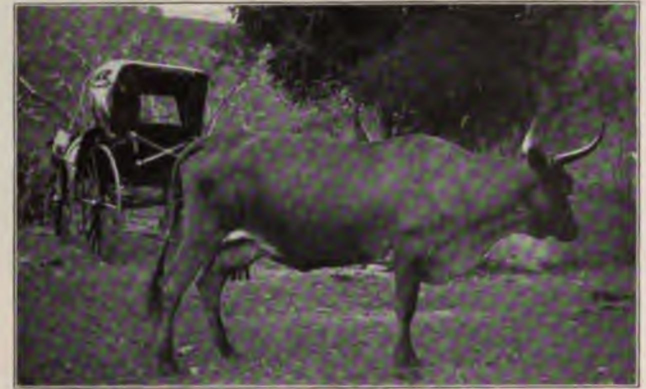


FIG. 1.—MILCH COW NEAR MAYAGUEZ.

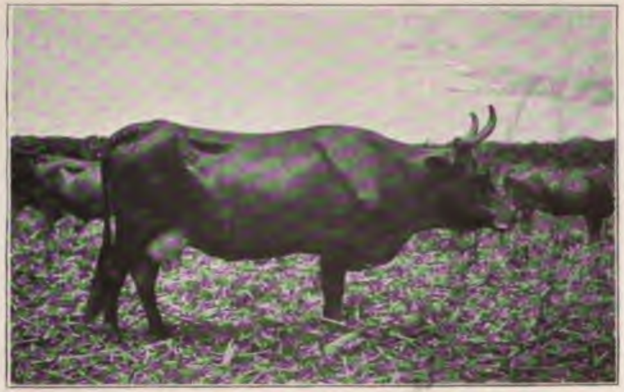


FIG. 2.—MILCH COW NEAR MAYAGUEZ.

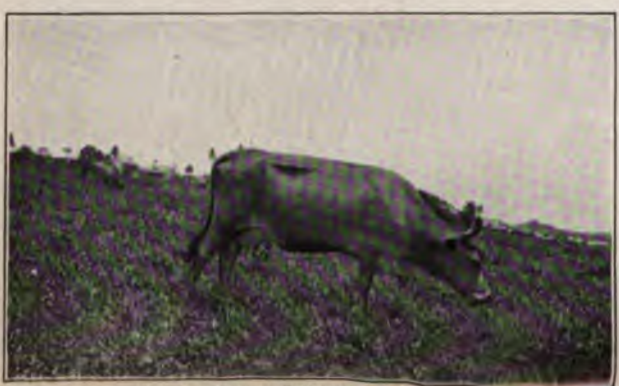


FIG. 3.—MILCH COW NEAR BAYAMON.

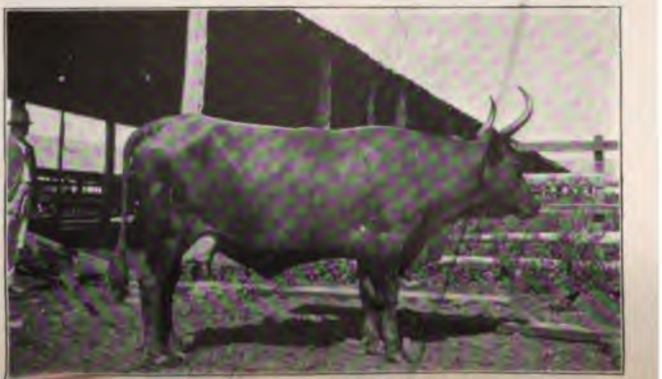


FIG. 4.—MILCH COW NEAR MANATI.

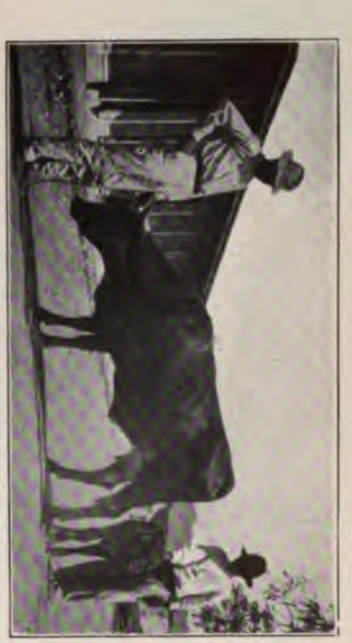


FIG. 1.—MILCH COW AND CALF NEAR COAMO.

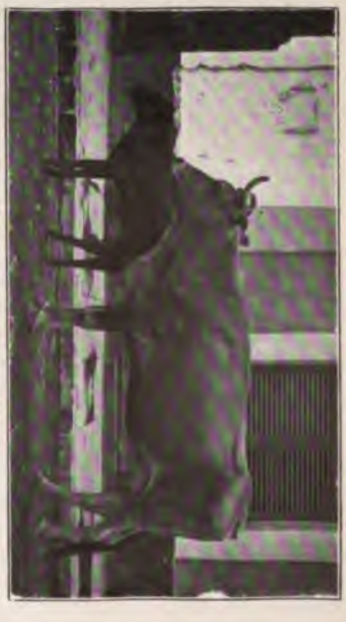


FIG. 2.—MILCH COW AND CALF.
Delivering milk in Ponce.

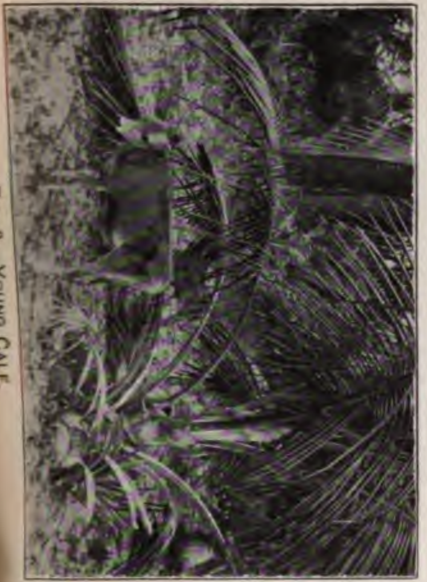


FIG. 3.—YOUNG CALF.
In natural pose and [illegible]

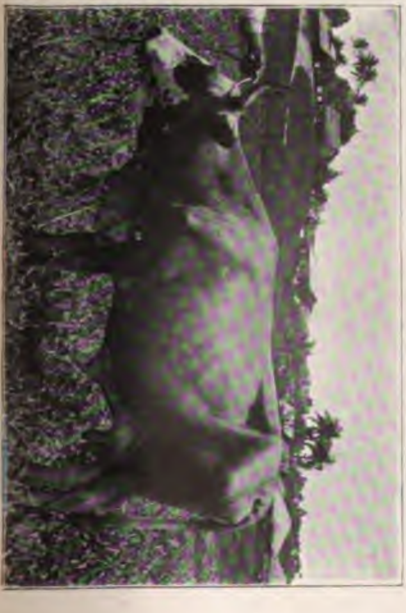


FIG. 4.—MILCH COW NEAR BAYAMON.

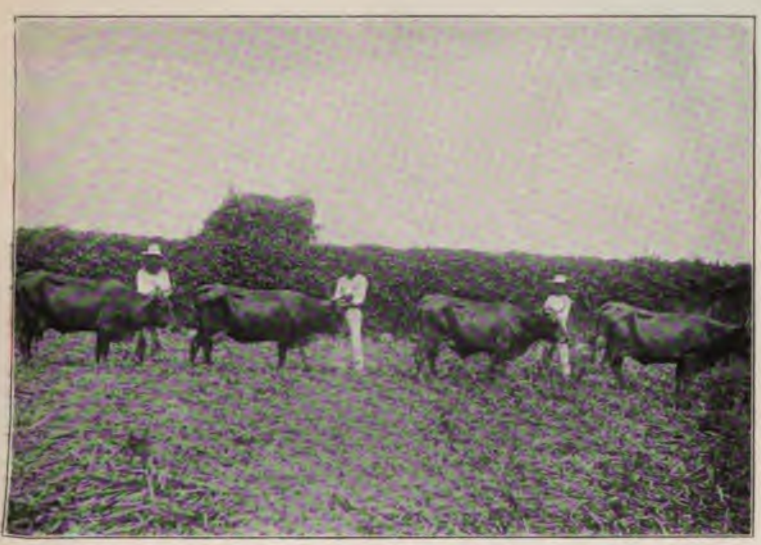


FIG. 1.—A PORTO RICAN "BIG FOUR."

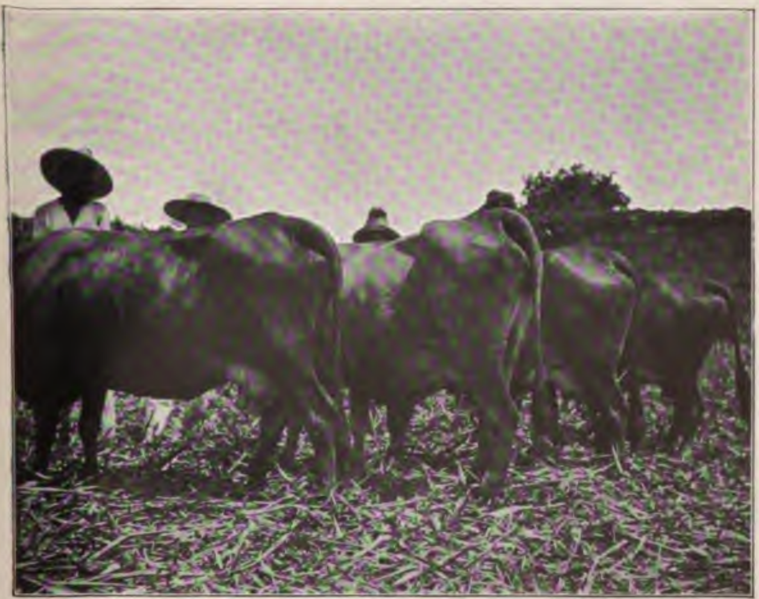


FIG. 2.—A PORTO RICAN "BIG FOUR."

mals for different districts in this country, the tastes of the owner should be the chief guide between the few breeds that are generally admitted to have superior dairy qualities. More depends upon this and the care to be given than upon the particular type selected. As Porto Ricans like beef qualities, it is probable that the larger breeds, some of them having claims for meat as well as milk production, would be most popular. The strictly dairy breeds seem to be preferred by some, however. This question was fully discussed with several stock owners, and one influential merchant and stockman near the center of the island decided to try Jerseys.

The few cattle already taken to Porto Rico from the States have, as a rule, received the same care given the natives, and they have not been kept pure. It is not strange, therefore, that results of their introduction are not more apparent. Only 2 animals which came from the States were seen; they were both near San Juan.

A young Durham bull (Pl. XLVII, fig. 1) was imported about a year ago through an exporting house in New York City. He cost his owner over $150. He did not appear to be in good condition, and the owner thought the climate did not agree with him. It is probable, however, that neglect was most responsible for his poor condition. His large "pasture" abounded with sand and cocoanut palms; it had but little grass and that was coarse. He was imported when about 6 months old.

Two Jersey heifers were taken to Porto Rico from Indiana by Commissioner Elliott of the Interior Department. They were about 18 months old when exported and were due to calve in 1 and 3 months, respectively. Both aborted. One of them, however, commenced giving milk, and after 3 months was giving about 8 quarts daily. She was fed 3 bunches of malojillo grass and about 2 quarts of a patent cattle food daily. She was seen by the writer, and her picture is shown on Plate XLVII, fig. 2. She has never been sick (though ticks have been on her), and is an excellent example of what might be done in the same way by others. The other heifer, said to be in good health, had been sent away to be bred.

Special care is necessary when sending cattle from the States to Porto Rico. Climatic as well as many other conditions differ greatly and the trip is not without hardships. As young cattle adjust themselves to new surroundings better than old ones, become acclimated more quickly, and are much less liable to be dangerously affected by Texas fever, which exists on the island, they should be selected when possible. A competent observer who has seen many shipments of cattle from our northern to infected southern districts agrees with advice heard in Porto Rico that shipments be made in the fall. He reports, also, that experience seems to prove that the kinds of cattle which do not carry much flesh do better than others when taken into a section where the fever is prevalent.

There is great ignorance regarding diseases which result in the death of stock, and many different forms of disease might be supposed to exist from descriptions of symptoms heard in different parts of the island. These dangers are doubtless greatly overestimated in many cases. A thorough investigation of the diseases of live stock would be of great benefit to the animal industry of the island.

MARKET MILK.

Milk is considered an important food and is very commonly used in Porto Rico. At least one or two cows are kept by almost every family living in the country and able to have them, and many residents of towns own cows. It is not uncommon to see cows being driven through the streets to be stopped and milked wherever their product is wanted. Their calves always accompany them (Pl. XLVIII, figs. 1 and 2). But much of the milk sold in larger towns is from near-by dairies, as is the case in the States. Milking is done at these dairies about 4 o'clock in the morning, as has been described, and the product, in 12 or 15 quart cans, having small mouths stopped with tin covers or banana leaves, is taken to the city in ox carts, on horseback, or carried by hand (or on the head) (Pl. XLVIII, figs. 3 and 4, and Pl. XLIX). It is distributed without cooling as promptly as possible after milking, and in the larger cities some is left at little milk shops and grocery stores. This latter is boiled soon after received and sold in small quantities as called for. If it is not all sold by 4 or 5 o'clock in the afternoon, it is boiled a second time. While awaiting sale it is often allowed to remain in an open vessel near an open door or window, surrounded by odors of native cheese, fruits, and vegetables, and uncleanliness indoors and out. There are a few milk shops where nothing but milk and native butter are sold, and at least one of these in San Juan was found to be kept in excellent condition. Milk from the large dairy described elsewhere is sold there, and, though cared for in general as already explained, more cleanly methods were practiced (Pl. L).

According to a statement kindly furnished by the mayor of San Juan, there are 56 places in that city where milk is sold at retail, and the quantity handled daily in these places is nearly 5,500 (small) quarts.

There is a wide variation in prices of milk at different times of the year and in different places. It is sold for 6 cents per quart in the larger cities, and for 3 to 5 cents in the smaller towns. These prices are higher and sometimes doubled during the short period known as the dry season. The wholesale price is 1 or 2 cents less than the retail. It should be noted, however, that the Porto Rican quart, which is referred to above, is equivalent to only about 1½ pints, or three-fourths of an American quart; hence prices are about one-third higher than it might seem to one not acquainted with the small measures. Milk is often sold in bottles which have previously been used for beer, wine, or other drink stronger than milk, and these are usually supposed to hold a quart, though they may contain not more than an American pint. At some places in San Juan milk is sold for 8 cents per liter (about $1\frac{1}{26}$ American quarts), and in Mayaguez the price is 8 to 10 cents per large, or American, quart, which is the measure used there.

Although there are many goats on the island, the sale of goats' milk was not noticed (Pl. LI).

In some cases municipal authorities are supposed to enforce laws requiring that milk sold in cities shall be pure and free from adulterants, but most of this kind of work which is done is performed by the superior board of health of Porto Rico. Its analyses show that market milk is sometimes watered to such an extent that the fat content falls considerably below 3 per cent.

Faults in the Porto Rican method of handling market milk are easily seen. Its poor quality, of which there is much complaint, is due chiefly to adulteration by water and to the system of milking by which the calf is allowed to have the last in the udder and the best that is given. The dishonest practice of adding water should be stopped by the punishment of guilty persons, and the system of milking might be changed as explained elsewhere. Boiling of milk is objected to by many. This treatment is considered necessary to prevent souring, as neither cheap ice nor cold water is available for cooling purposes. It is not unlikely that many Porto Ricans would object to receiving cold milk, as they have never had it, and would consider it old or otherwise undesirable. Attempts have been made to sterilize milk by modern methods at dairies near Mayaguez and Manati, but they were unsuccessful, and the enterprising dairymen who had invested considerable money in European appliances for sterilizing became discouraged and are now following the usual methods.

It is probable that milk could be handled satisfactorily under present conditions without boiling it, thus avoiding the disagreeable taste and other undesirable changes due to high heat. In a few cases, where dairies are near an ice-supply plant, a small amount of ice could be used for cooling. The price at which milk is sold would enable dairymen to purchase a little ice even at an exorbitant rate. Pasteurization could be practiced to great advantage. This is evident to anyone familiar with the pasteurization of milk, and is plainly shown by a few experiments conducted, at the suggestion of the writer, by Mr. C. F. Doane, of the Maryland Experiment Station. These experiments were performed in the summer at the experiment station, and under conditions which were made as nearly as possible like the conditions easily obtainable in most parts of Porto Rico. If any error was made it is believed the conditions in Maryland, so far as temperature is concerned, were less favorable to the milk than those found at most Porto

Rican dairies. The experiments were as follows: The milk was drawn in a cleanly manner, promptly aerated, and allowed to stand in a warm place until about thirty minutes after milking, when it was cooled to 80°. A part of the milk was then set aside in a room where the temperature was between 79° and 83°, and the can containing the remainder was placed in a tank of hot water, the milk being stirred until the temperature was raised to 150°, at which point it was held thirty minutes, then quickly cooled to 80° by changing the can to a tank of cool water. It was then placed in the same room with the sample which had not been heated and cooled. It was found by repeated experiments that this treatment was an effective means for keeping milk in good condition about seven hours longer than was possible when it was not specially treated. In some cases it remained fit for use twenty-four hours after milking.

Similar results are reported by Prof. Harry Hayward, of the Pennsylvania Experiment Station, who performed practically the same experiments for the writer. This method has three great advantages, namely: It is inexpensive and simple of operation, it prolongs the life of the milk, and it does not cause any unpleasant taste or appearance in the milk, although Professor Hayward notes a slight change in the flavor, best described as "lack of freshness." One condition is absolutely necessary for success, and that is *cleanliness*, especially of vessels used to hold the milk, and good results need not be expected unless it is carefully attended to. Each vessel should be carefully cleaned each time after it has been used and then rinsed with boiling water, or better, immersed for several minutes in boiling water, then kept in a clean, dry place until again needed for use. Washing powders, when used liberally, are found to possess disinfectant properties as well as power to cleanse.

There is little doubt that at many dairies in Porto Rico even better results than above reported could be obtained. For example, if the milk were heated within a few minutes after being drawn instead of a half hour, as was the case in these experiments, it probably would keep even longer. It would also be possible at most dairies to cool it considerably below 80°, which would prolong its time of keeping sweet. Mr. Doane found that when cooled to 75° after heating, as could easily be done at many Porto Rican dairies supplied with cool springs, its life was increased to about thirty hours—or as much as six hours beyond the time the milk cooled only to 80° remained good. Where still lower temperatures can be used the length of time the milk will remain sweet will be still more prolonged. It is not unusual in American cities to sell milk handled in this way, but cooled to about 40°, and when it is three or four days old it may easily be more wholesome than milk only a few hours old, but which has been carelessly produced and handled.

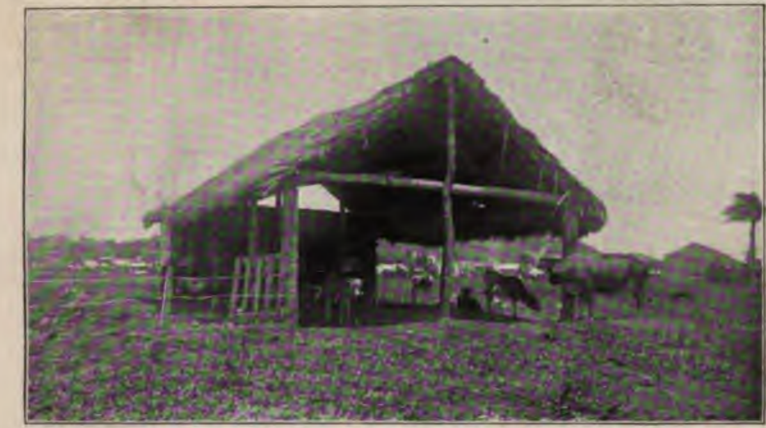


FIG. 1.—COW SHED NEAR BAYAMON.

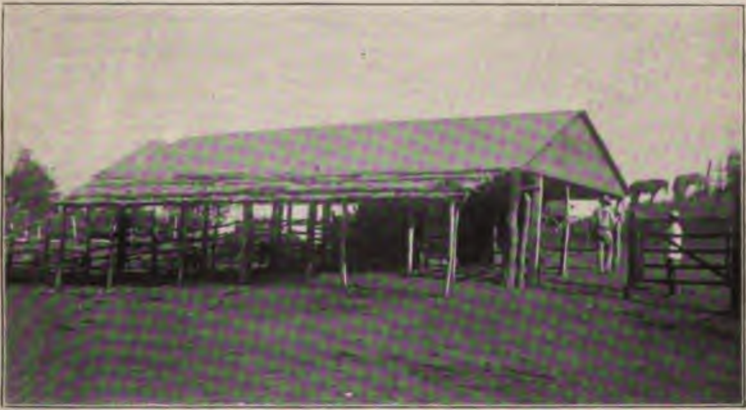


FIG. 2.—COW SHED NEAR JUANA DIAZ.

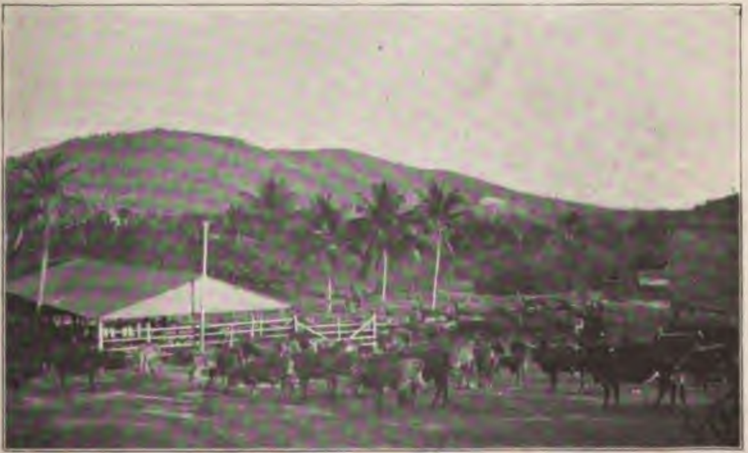


FIG. 3.—COW SHED AND HERD NEAR PONCE.

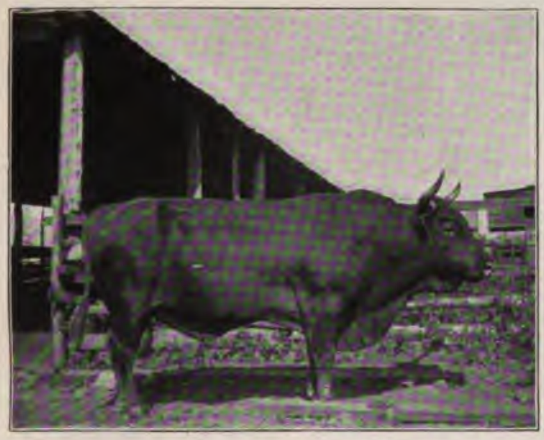


FIG. 1.—DURHAM BULL.

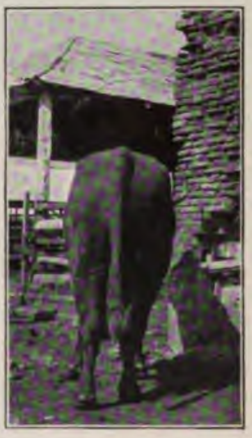


FIG. 2.—SAME (REAR VIEW).

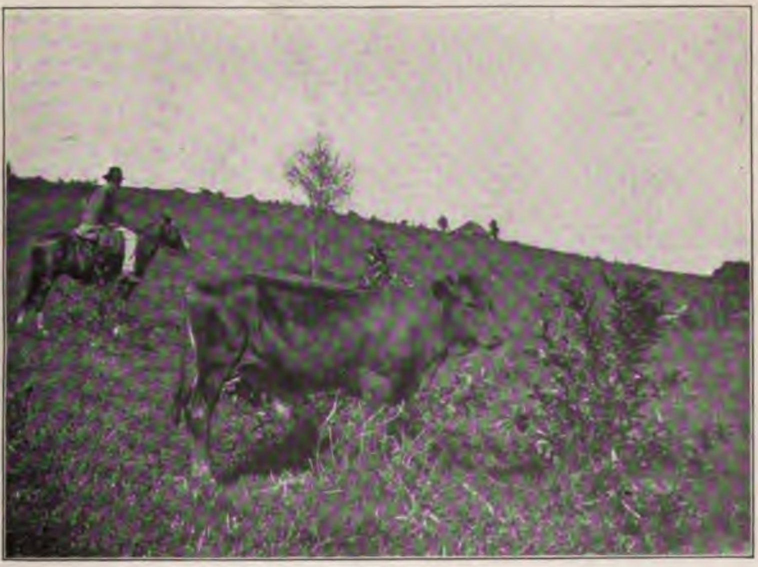


FIG. 3.—NATIVE CALF.
Sired by Durham bull.

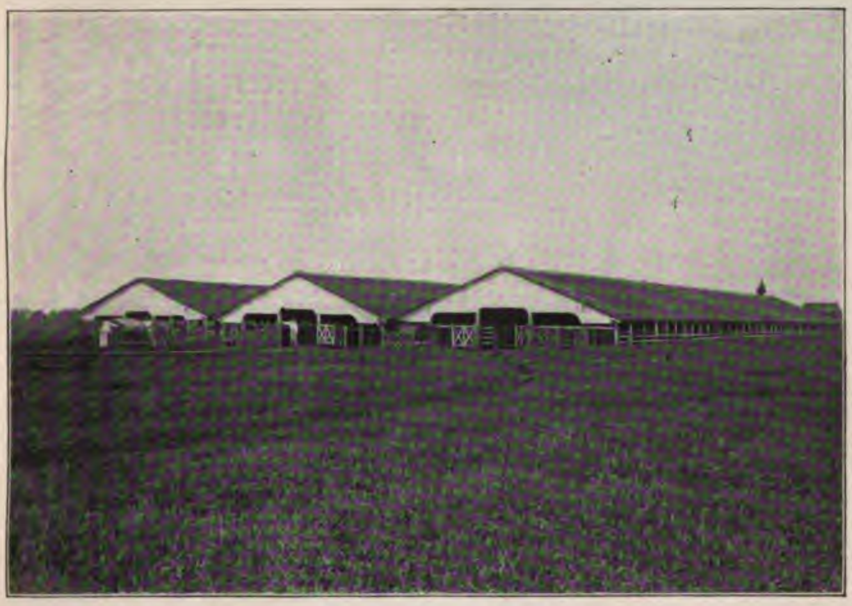


FIG. 1.—DAIRY BUILDINGS NEAR SAN JUAN.

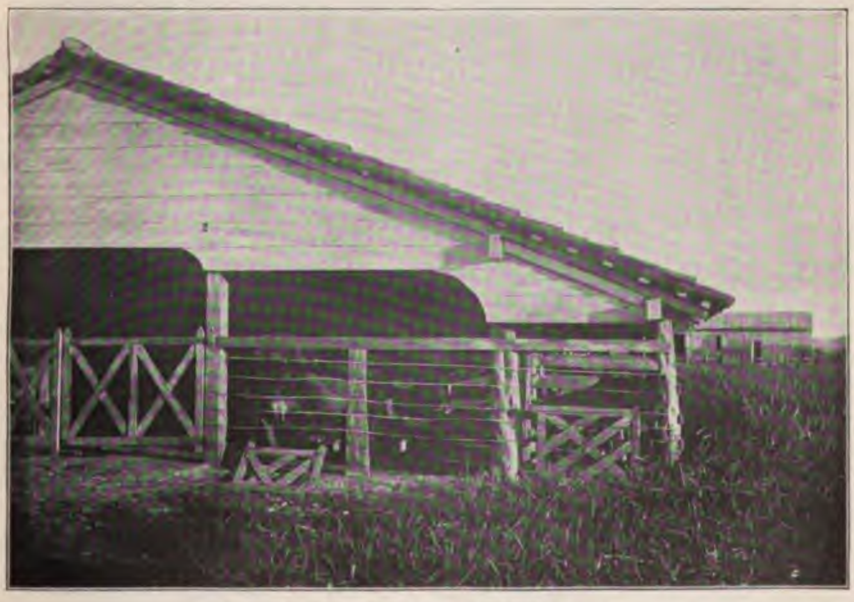


FIG. 2.—DAIRY BUILDINGS NEAR SAN JUAN.
Showing small pen for calf in front of cow.

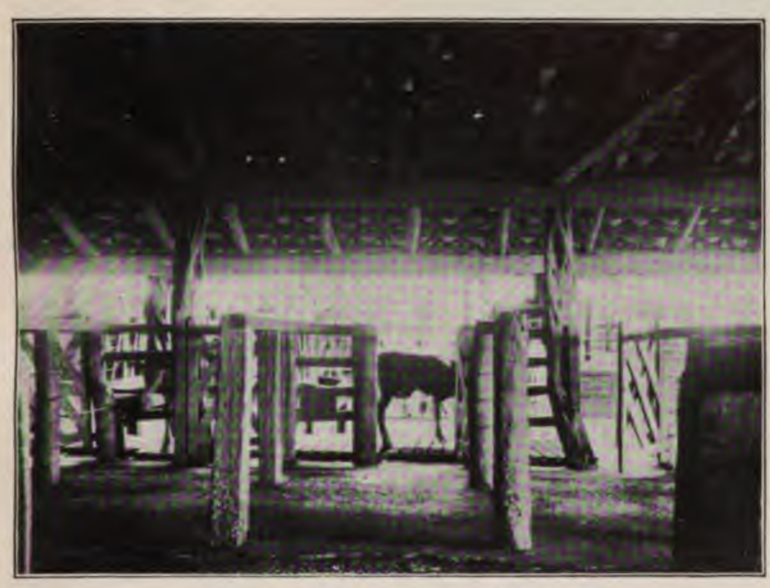


FIG. 1.—COW STALLS AND CALF PENS.
In shed shown on preceding plate.

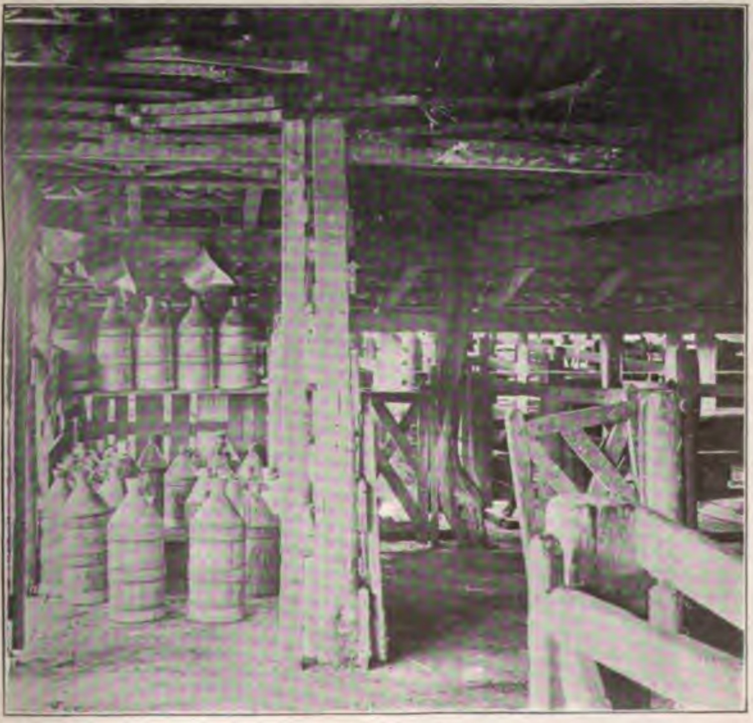


FIG. 2.—MILK ROOM IN SAME SHED.

INTERIOR OF COW SHED NEAR SAN JUAN.

A convenient and clean way of handling milk would be to put it in milk bottles or small cans as soon as it has been strained and place these in hot and cold water in turn.

It is doubtful if any kind of agriculture in the vicinity of a Porto Rican city would respond with profit as quickly and as generously as would a dairy managed intelligently and economically along modern lines.

NATIVE BUTTER.

Butter is made in Porto Rico, but it is a very different article from the butter to which Americans are accustomed. It is not made in sufficient quantity to have much effect on the market, and it is not sold in the better class of grocery stores where imported butter is on sale. It is produced in the crudest fashion by shaking milk or cream in a wide-mouth fruit jar, and the finished product is generally heavily salted. The custom of boiling milk is referred to elsewhere. Frequently the "cream" used for making butter consists largely of the scum of boiled milk and is but little richer in fat than normal milk. As neither ice nor cold water is used to reduce the temperature during "churning," the soft fat globules are not thoroughly separated from the casein and water, and the butter contains a great excess of these constituents. Sometimes it is practically the same in composition and appearance as thick sour cream. The analysis of a sample purchased in a milk shop showed less than 60 per cent of fat (No. 55, table 6). It is difficult to describe the taste of this sample, but one can easily imagine that it was by no means free from both acidity and rancidity. Early every morning small boys go through the streets of San Juan calling loudly "Mantequilla del Pais" (butter of the country). One of these little salesmen was photographed and questioned. His stock consisted of 60 small pats of "mantequilla" on a plate which he carried on his head. The pats weighed about two-thirds of an ounce each, and were sold for 1 cent, making the rate 24 cents per pound (Pl. LII, figs. 1 and 2). This butter was found to contain as high as 64 per cent of water, and less than 30 per cent of fat (No. 54, table 6). The little fellow said he was given his meals and 10 cents a day for his work, but even this expense must have left some profit! The place where this butter was made was visited, and a woman frankly explained that she beat the "cream" from the milk of her 3 cows with a stick in a tin pail and added to it some canned Spanish butter. The latter was badly spoiled and gave a strong and most unpleasant flavor to her product. It is doubtful if her patrons, who were generally of the lower classes, made much protest on account of unsatisfactory flavor.

To correct the belief of anyone that good butter can not be made in Porto Rico, it may be said that the Government official already referred to as having taken two Jerseys to the island, keeps his household supplied with excellent butter made at frequent intervals. He uses ice for controlling temperature of cream before and during churning and to keep the finished butter cold. This subject was given special attention, and no reason was seen why good butter can not be made at any place on the island where ice is available. The milk of Porto Rican cows is even richer in fat than that from many herds regularly supplying milk to American creameries, and the atmospheric temperature is never so high as it often is for days in succession in some of the districts in this country where the finest butter is made. Next to a supply of milk, ice is essential, and anyone who would make butter must do it near one of the two or three ice factories now running, or operate a plant on such a scale that an independent ice machine could be installed. The cost of ice is very high. It is sold at the San Juan and Ponce factories (Pl. LIII, fig. 3) at 80 to 90 cents per 100 pounds, and it is retailed in those cities at 2 cents for about 1 pound. In interior towns it is sold as high as 5 or even 8 cents per pound. Two or three of the several ice plants installed are now idle. Porto Ricans have not yet learned to use ice; the market for it is therefore very limited, and this accounts for the exorbitant prices.

NATIVE CHEESE.

Native Porto Rican cheese is a product of considerable importance. It is made on most farms where cows are kept and where the milk is not disposed of for consumption, but it is generally made only during the rainy season, when milk is plentiful. It is sold principally in small shops and is seldom used by the well-to-do classes. A sample of this cheese was found to contain 27.17 per cent fat (No. 104, table 11).

Three different kinds of Porto Rican cheese are as follows, according to descriptions of Mr. José L. Fajardo, school supervisor at Manati, who has had experience in their making:

Pressed cheese (*queso de prensa*) is a common form, and its method of manufacture is in some respects similar to the method of making brick cheese. The cows are milked about 4 o'clock in the morning, and the milk is carried to the cheese room, where it stands without cooling about six hours. Rennet, which has been made by soaking in whey the salted lining of the stomach of a calf for twenty hours, is then added. In about thirty minutes curd has formed and it is broken with the hands or a stick. When the whey is separated the curd is transferred to a table and broken into small pieces. It is then put into wooden forms about 11 inches long, 5½ wide, and 6 deep, and pressed with light weights. On some farms cheese is pressed with the aid of a screw. Salt is added while the curd is being put into the frames or it may be placed all together on top of the curd. After six hours each cheese is turned in the frame and the next day they are placed on racks made of narrow slats. The finished cheese has the same length and width as the forms and is about 3 inches thick, and weighs about 5 pounds. It is sold to the stores at $8 to $10 per 100 pounds and is retailed at about 12 cents or a little more per pound. Twelve pounds of milk are said to be necessary for 1 pound of cheese. The custom is to sell the cheese fresh, or at least once a week. But this cheese is said to keep well for two or three months. It, of course, cures during this time and must be carefully treated, especially during the first two weeks, when it is turned two or three times a day and often washed with whey (Pl. LII, fig. 3).

Mashed cheese (*queso de puño*, or *amasado*) is the native cheese commonly seen in the small stores. It is quite similar to our cottage cheese. The curd is obtained as described above; it is thoroughly mashed on a table with the hands, and salt is added. It is then put into a hoop about 5 inches in diameter and 1¼ inches deep, where it remains without pressure for two or three days, or until it will hold its form; it is then ready for sale. It is said that about 12 pounds of milk are required for one of this kind of cheese, for which the maker receives 12 to 15 cents at the store, the retail price being 25 to 30 cents. Sometimes it is sold by the pair, little attention being given to weight, though this varies considerably. This cheese does not keep long, and must be occasionally rinsed in brine.

Leaf cheese (*queso de hoja*) is less common than the two preceding, and it is supposed to be more choice. The fresh curd is cut into blocks about 6 inches square and 2 inches thick. After a part of the whey is drained off, which may require several hours, or less if it is squeezed, these pieces are immersed (sometimes suspended in a cloth) in water or whey having a temperature of about 150° F. In a few minutes, when the curd has become more tough and elastic, it is removed to a flat surface and manipulated and stretched by the use of a broad wooden spoon. During this operation salt is added and the curd is folded back upon itself. Finally, it is wrapped in a cloth and squeezed by hand to force out moisture. The finished product is disk shaped, about 6 inches in diameter, and having the top and bottom surfaces slightly rounded. When the cheese is cut it appears to be in layers, as leaves, one upon another. The maker of this cheese sells it to the storekeeper at 12 to 15 cents per cheese, and it is retailed as high as 25 cents. Four to 6 quarts of milk are required for one cheese.

In some cases, it is said, a part of the cream is removed from the milk before cheese is made for the purpose of making butter.

A good opening undoubtedly awaits the person who will make in Porto Rico a good quality of cheese from milk economically produced. There seems to be no reason why many varieties of cheese can not be made, and an excellent home market could certainly be had almost without effort. At certain times of the year milk could, under present conditions, be bought for this purpose at a reasonable rate, but at other times—the dry seasons—it is greatly reduced in quantity, and perhaps could not be had at all. Cheese making should follow closely the improvement of dairy stock and an increased supply of milk.

IMPORTED BUTTER OF PORTO RICO.

Roughly estimated, about 1,000 pounds of butter are used in Porto Rico each day. Practically all is imported. It is evident that this article does not form a very important part of the food of the nearly 1,000,000 people of the island, notwithstanding the fact that it is generally favored as being beneficial to health, and many persons think they use a large amount of it. Principally on account of their poverty many people use no butter, and at numerous grocery stores in the poor districts it is not sold. A considerable portion of the population consider butter a luxury and purchase it only on special occasions, while those who use it regularly seldom have it for any other meal than the first of the day, or "coffee." A great many stores sell no more than 40 or 50 pounds in a week.

STATISTICS.

So far as they are available the official statistics of imports of butter in recent years have been compiled (table 3, p. 327). They show considerable fluctuation in the trade with each country named. The United States and Spain have supplied much more than any other country, receipts from each having in certain years exceeded 200,000 pounds. The statistics are misleading, however, for the reason that a large amount of oleomargarine has been supplied from the States, as is shown elsewhere, and this was entered as butter. It is claimed that oleomargarine is not received from any other country. Denmark, Germany, the United Kingdom, and Italy have been other important countries of supply.

Monthly statistics of imports are available for the period since the island has been under the control of this Government (table 4, p. 328). They show much variation in the quantity of receipts from month to month and that the shipments of butter (and oleomargarine) from the States have greatly increased, while the receipts from other countries have decreased. In recent months the receipts from the States have been over 25,000 pounds; they were as large as 43,091 pounds in May, 1901, in which month the total receipts from all other countries were only 12,859 pounds.

The following tables, as well as most of the trade statistics in this report, have been compiled from reports and special statements obtained from the War and Treasury Departments, and in some cases with the assistance of the Section of Foreign Markets of this Department:

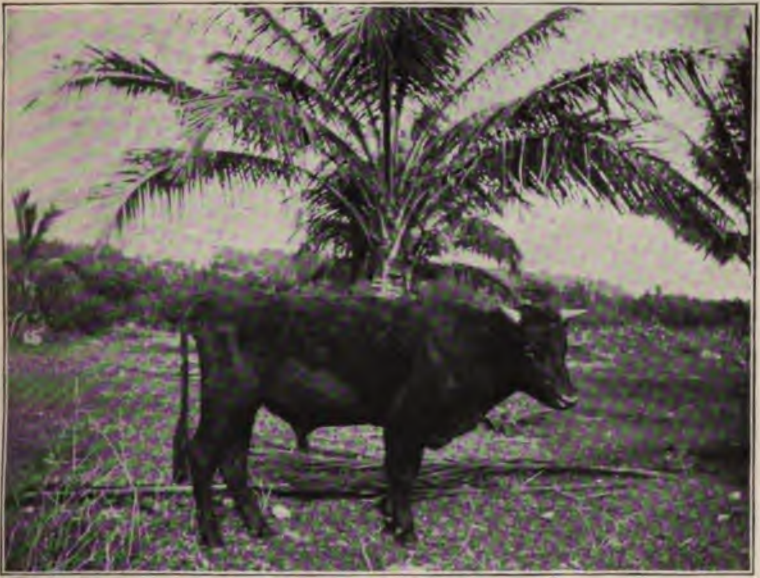


FIG. 1.—DURHAM BULL FROM THE UNITED STATES.

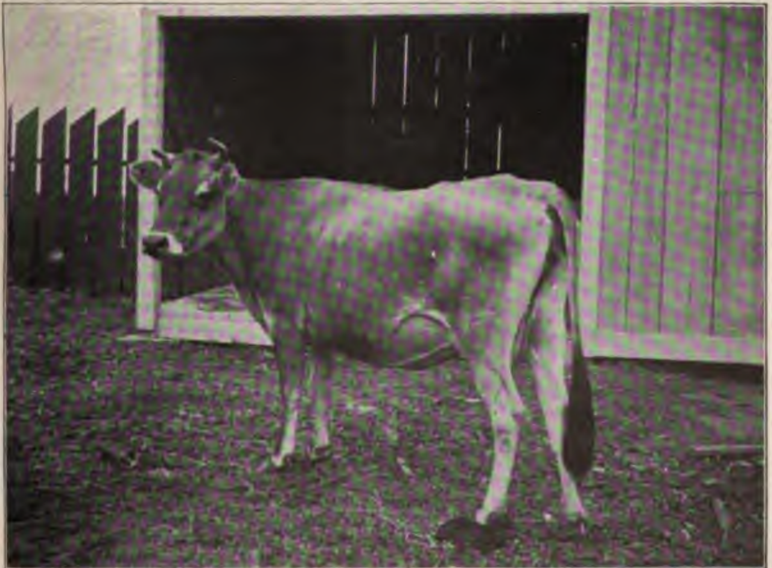


FIG. 2.—JERSEY COW FROM THE UNITED STATES.

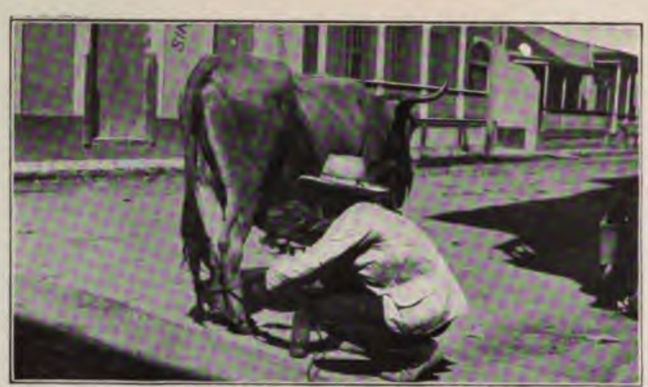


FIG. 1.—DELIVERING MILK IN PONCE.
While the attendant ties the legs the calf "starts" the milk.

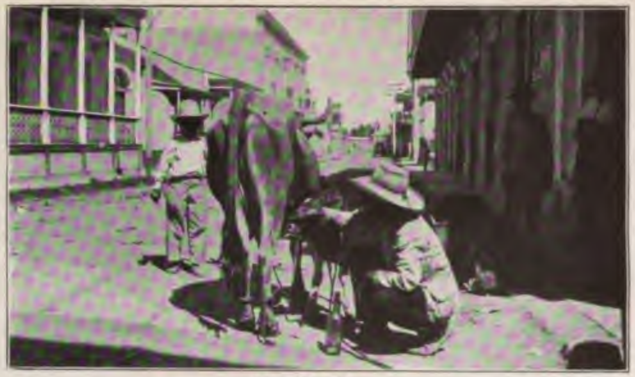


FIG. 2.—SAME.
The calf is pushed back and milk drawn into a bottle.

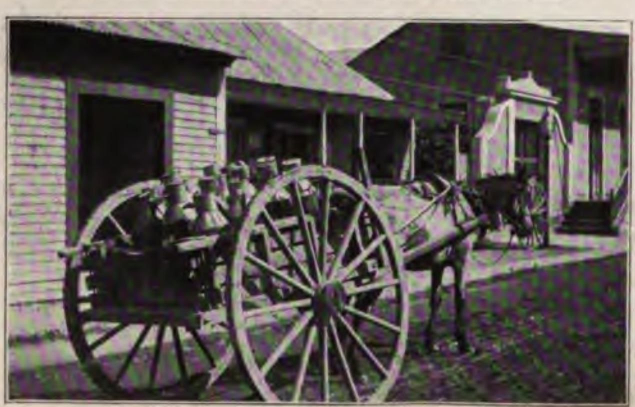


FIG. 3.—DELIVERING MILK IN PONCE.

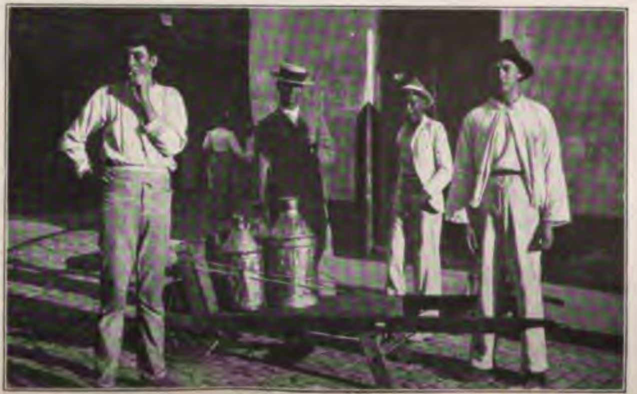


FIG. 4.—DELIVERING MILK IN SAN JUAN.

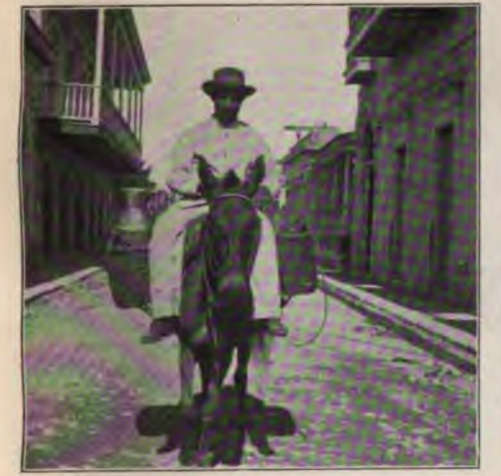


FIG. 1.—DELIVERING MILK IN SAN JUAN.

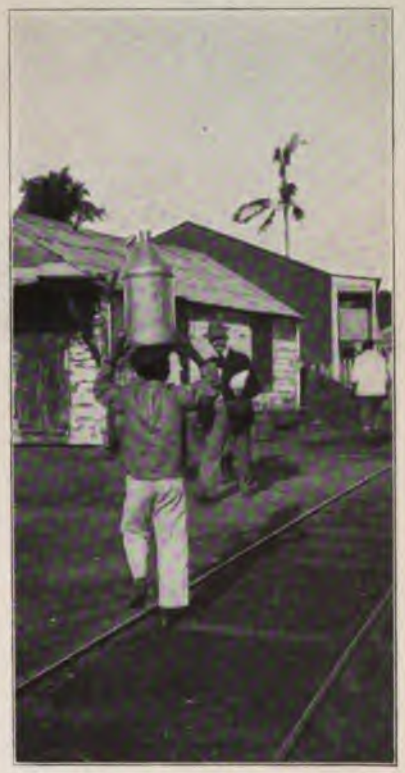


FIG. 2.—DELIVERING MILK IN BAYAMON.

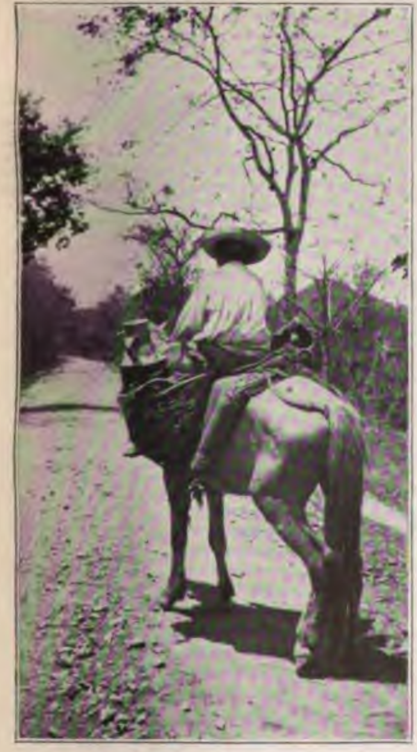


FIG. 3.—TAKING MILK TO COAMO.

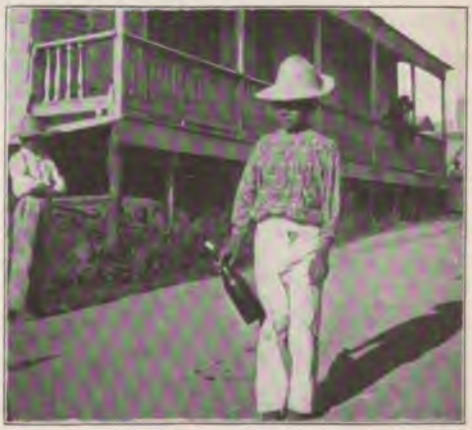


FIG. 4.—DELIVERING MILK IN AIBONITO.

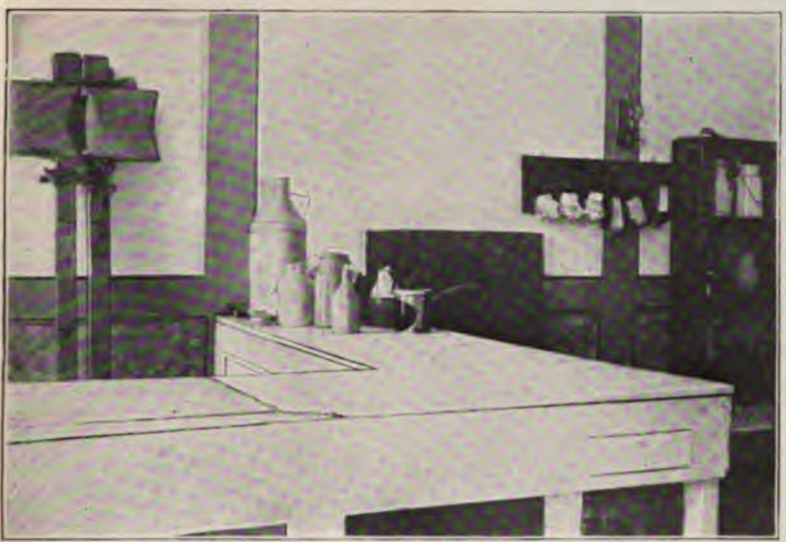


FIG. 1.—INTERIOR OF A SAN JUAN MILK STORE.

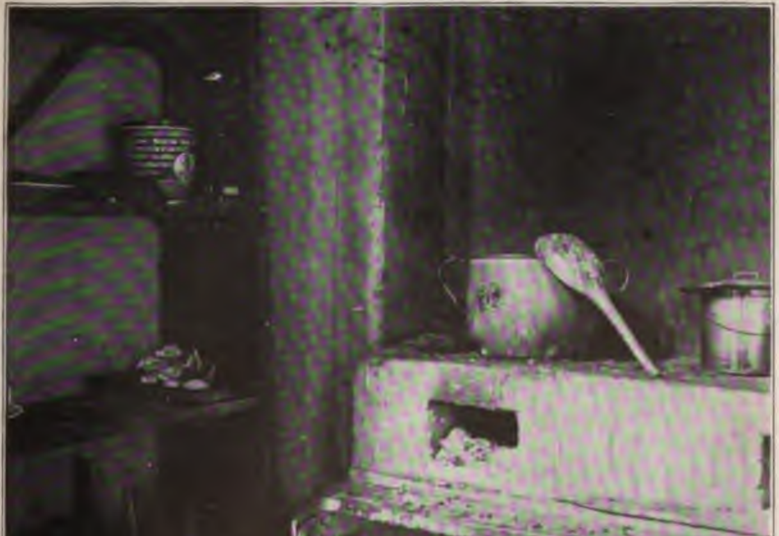


FIG. 2.—INTERIOR OF A SAN JUAN MILK STORE.
The back room where milk is boiled.

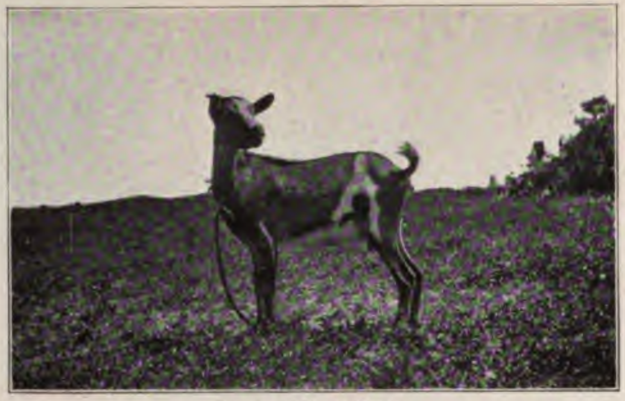


FIG. 1.—MILCH GOAT.

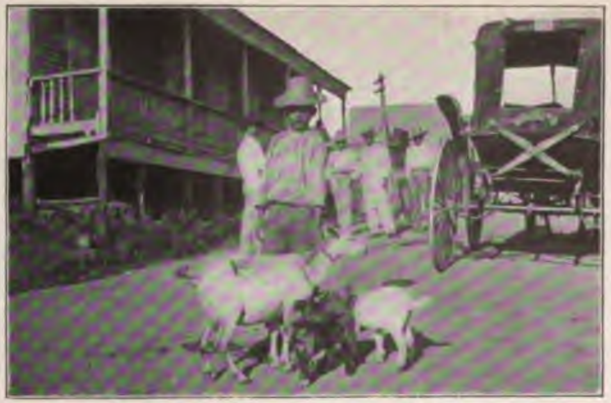


FIG. 2.—MILCH GOAT AND KIDS.

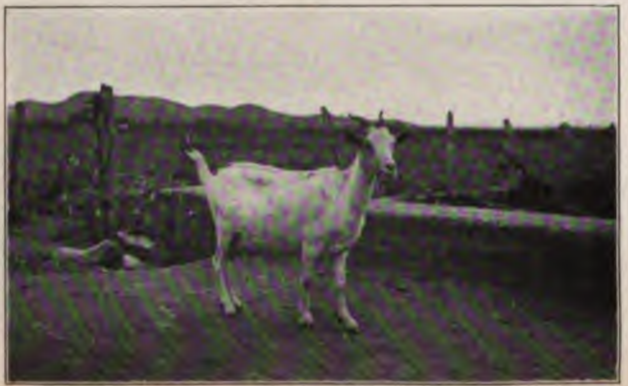


FIG. 3.—MILCH GOAT.

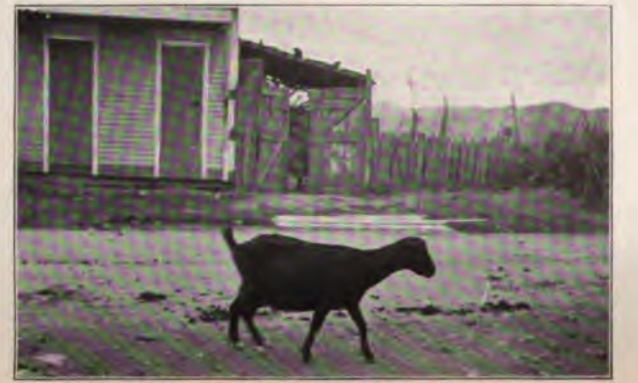


FIG. 4.—MILCH GOAT.

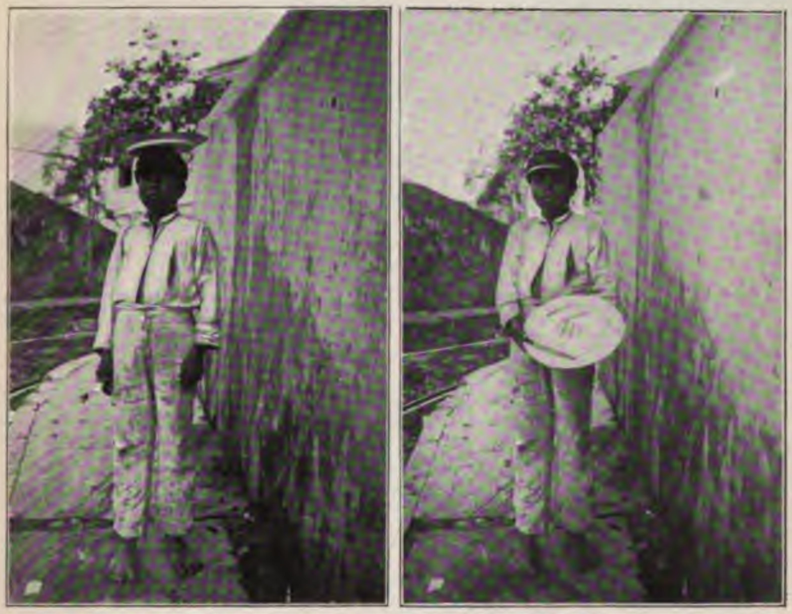


FIG. 1.—BOY SELLING NATIVE BUTTER IN SAN JUAN.

FIG. 2.—SAME.

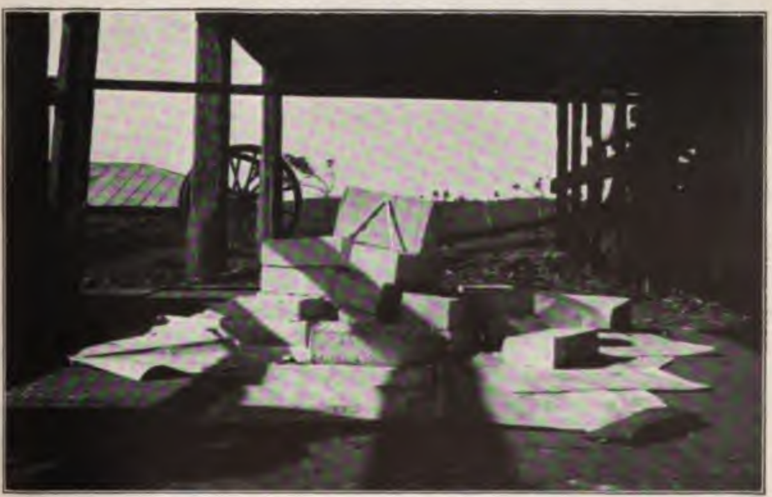


FIG. 3.—NATIVE CHEESE READY FOR MARKET.

The size of the cheese is shown by the foot rule.

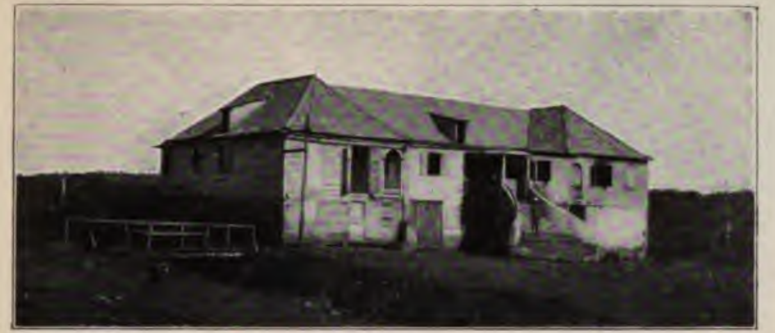


FIG. 1.—RESIDENCE ON A LARGE ESTATE.

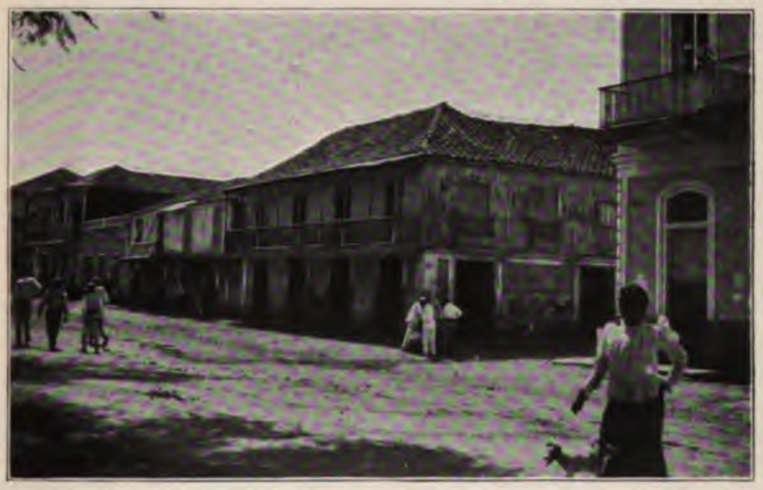


FIG. 2.—STORE IN A SMALL TOWN.

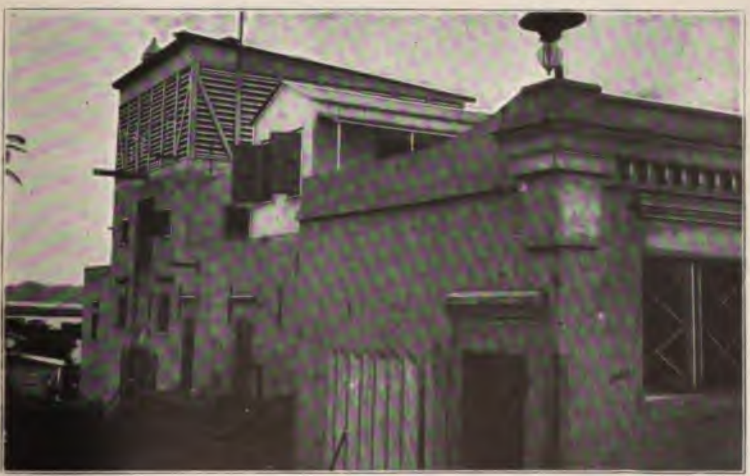


FIG. 3.—ICE PLANT AT SAN JUAN.

TABLE 3.—*Butter imported into Porto Rico during the calendar years 1893-1901*

Country of export.	1893.	1894.	1895.	1896.	1897.	1898.[a] Sept.-Dec.	1899.	1900.	1901.[a] Jan.-May.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
United States[b]	240,837	116,764	....	31,173	62,807	32,351	285,970	226,258	153,530
Other countries	....	....	....	....	....	....	172,734	....	40,409
Spain	123,934	67,637	....	208,952	166,531	6,645	....	22,209	....
Germany	4,960	19,317	....	7,970	23,439	4,257	....	4,745	....
Denmark	4,423	17,064	....	32,937	22,361	8,332	....	32,573	....
United Kingdom	14,156	36,433	....	3,073	14,583	....	....	6,033	....
Italy	12,608	25,027	....	20,732	6,292	2,733	....	15,261	....
Belgium	....	....	....	....	2,260	....	....	....	....
Netherlands	908	1,213	....	3,406	1,764	....	....	....	....
British Possessions	....	....	....	....	796	....	....	....	....
France	646	11,426	....	5,002	697	....	....	340	....
Austria-Hungary	....	....	....	4,279	....	....	....	50	....
Cuba	....	3,245	....	....	....	....	....	....	....
Danish West Indies	....	....	....	....	....	275	....	....	....
Total	402,472	298,126	365,831	317,524	301,530	[a]54,593	458,704	307,469	[a]193,939

[a] Portion of a year as shown.

[b] Oleomargarine from the United States was entered as butter.

Most of the butter is received at San Juan, but a large portion of that sent from the States is entered at Ponce; in some months about half of it goes to that port.

In this connection the changes of tariff may be noted. From the date of occupation until April 30, 1900, the customs were in charge of the War Department of the United States, and during this period it is understood the duty collected on all imported butter (and oleomargarine) was nearly 1 cent per pound ($2.10 per 100 kilograms). On May 1, 1900, the collection of customs was assumed by the United States Treasury Department, and the tariff law of the United States took effect. Importations from the States, however, were obliged to pay 15 per cent of full tariff rates. Under this arrangement 6 cents per pound was collected upon butter from all foreign countries, while the duty upon shipments from the States was only 0.9 cent per pound. Usual and necessary tin coverings of butter are not dutiable. (All duties upon shipments between the States and Porto Rico were abolished July 25, 1901, making trade with Porto Rico as free as between States.)

The statistics of exports from the United States exhibit much of interest in this connection (table 5). It is surprising to find that the quantity of butter reported as being exported to Porto Rico in early years, as far back as 1855, was very large compared to the present trade. In some years it exceeded the combined quantity of butter and oleomargarine sent in any recent year. It is impossible to comment upon these old statistics—to state the character of the trade of the "sixties" and "seventies," or to explain what became of the butter reported.

TABLE 4.—*Butter (and oleomargarine) imported into*

Year and month.	United States.		Denmark.		France.		Spain.		
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
1898.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	
September[a]	1,413	203	1,195	1,453	....	....	....	....	1
October	5,500	1,113	....	....	....	....	....	....	2
November	7,880	1,195	....	....	....	....	....	....	3
December	17,558	4,248	7,137	1,192	....	....	6,645	612	4
1899.									
January	10,852	2,726	7,502	1,333	....	....	3,926	169	5
February	27,777	2,708	2,779	493	204	31	....	....	6
March	27,391	2,657	....	....	....	....	16,576	1,683	7
April	18,511	1,928	1,850	456	....	....	6,234	1,057	8
May	18,140	1,666	....	....	....	....	....	....	9
June	35,554	3,599	....	....	....	....	....	....	10
Total, 10 months	170,579	22,043	[d]20,463	[d]4,927	[d]204	[d]31	[d]33,381	[d]3,521	11
July	31,276	2,884	2,708	569	239	36	6,417	1,464	12
August	34,796	3,369	8,485	1,829	406	59	12,845	1,895	13
September	19,710	2,766	5,532	1,012	....	....	....	....	14
October	9,183	975	3,878	998	123	33	7,713	1,453	15
November	26,585	2,277	2,069	488	....	....	....	....	16
December	26,192	2,242	7,003	1,830	191	63	3,650	559	17
1900.									
January	9,165	896	3,652	926	150	32	326	120	18
February	12,473	1,330	3,301	852	....	....	3,084	576	19
March	7,880	718	3,762	1,091	....	....	3,028	375	20
April	12,078	1,361	9,005	2,649	....	....	1,263	212	21
May	20,876	2,492	1,924	756	....	....	3,863	489	22
June	40,061	5,087	1,764	710	....	....	....	....	23
Total, 12 months	250,275	26,397	53,083	13,710	1,109	223	42,139	7,143	24
July	23,926	3,578	2,663	888	....	....	....	....	25
August	29,938	3,893	960	317	....	....	....	....	26
September	6,445	1,431	1,616	600	40	5	7,249	1,467	27
October	26,055	3,666	1,080	431	....	....	1,100	530	28
November	16,656	2,220	2,846	1,169	....	....	....	....	29
December	20,705	3,440	....	....	150	51	2,346	232	30
1901.									
January	29,982	3,690	3,316	1,321	....	....	....	....	31
February	14,642	2,267	1,960	696	....	....	9,399	1,994	32
March	39,065	6,621	1,623	619	....	....	5,602	1,202	33
April	26,800	4,020	....	....	....	....	....	....	34
May	43,691	5,990	....	....	....	....	....	....	35
Total, 11 months	277,255	40,819	[d]16,064	[d]6,041	[d]190	[d]56	[d]25,696	[d]5,425	36
June	....	....	1,882	721	....	....	2,910	617	37
July	....	....	3,465	1,401	....	....	2,416	548	38
August	....	....	960	358	....	....	....	....	39
September	....	....	2,091	796	....	....	....	....	40
October	....	....	6,422	2,517	50	17	....	....	41
November	....	....	1,857	812	....	....	1,500	263	42
Total, 6 months	....	....	16,677	6,605	50	17	6,826	1,428	43

[a] Mayaguez, Ponce, Arroyo, Aguadilla, and Humacao, only ports occupied in September, 1898.

[b] Includes 25,836 pounds, valued at $4,335 for May, from countries other than United States.

[c] Includes 14,881 pounds, valued at $2,688 for June, from countries other than United States.

[d] Except for months necessarily omitted when imports from several countries are combined into one item, as shown.

Porto Rico, by months, September, 1898, to May, 1901.

	Italy.		United Kingdom.		Germany.		Netherlands.		Other countries.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dolls.*	*Pounds.*	*Dolls.*	*Pounds.*	*Dollars.*
1	....	....	....	....	1,317	453	....	....	....	....	3,925	2,109
2	....	....	....	....	....	....	....	....	....	....	5,500	1,113
3	573	115	....	....	....	....	....	....	....	....	8,453	1,310
4	2,160	397	....	....	2,940	513	....	....	275	44	36,715	7,006
5	630	95	....	....	1,763	540	....	....	....	....	24,673	4,863
6	....	....	1,741	168	1,313	195	....	....	....	....	33,814	3,595
7	....	....	....	....	....	....	1,533	306	....	....	45,503	4,646
8	....	....	1,877	492	2,071	451	....	....	150	31	30,693	4,415
9	....	....	....	....	....	....	....	....	....	....	[b]43,976	[b]6,001
10	....	....	....	....	....	....	....	....	....	....	[c]50,435	[c]6,287
11	[d]3,363	[d]607	[d]3,618	[d]660	[d]9,404	[d]2,152	[d]1,533	[d]306	[d]425	[d]75	283,687	41,345
12	1,345	145	....	....	1,086	249	....	....	....	....	43,071	5,347
13	....	....	2,293	575	2,165	207	....	....	....	....	60,990	7,934
14	2,719	629	611	73	1,336	341	....	....	103	45	30,011	4,866
15	2,150	417	371	63	....	....	....	....	....	....	23,418	3,939
16	....	....	519	125	588	31	....	....	2,084	505	31,845	3,429
17	....	....	519	102	2,720	776	....	....	....	....	40,275	5,572
18	2,413	220	645	174	....	....	....	....	....	....	16,351	2,368
19	804	146	....	....	....	....	....	....	....	....	19,612	2,904
20	4,250	892	1,197	278	....	....	....	....	....	....	20,117	3,354
21	....	....	2,410	584	2,675	713	....	....	....	....	27,431	5,519
22	460	39	....	....	....	....	....	....	....	....	27,123	3,776
23	300	58	536	133	....	....	....	....	....	....	42,661	5,988
24	14,441	2,546	9,101	2,107	10,570	2,320	....	....	2,187	550	382,905	54,996
25	1,746	225	....	....	....	....	....	....	....	....	28,335	4,691
26	1,300	193	....	....	....	....	....	....	50	57	32,248	4,460
27	....	....	....	....	....	....	....	....	....	....	15,350	3,503
28	882	222	670	172	1,182	238	....	....	....	....	30,969	5,259
29	506	111	....	....	888	341	....	....	....	....	20,896	3,841
30	2,600	382	575	160	....	....	....	....	....	....	26,376	4,265
31	....	....	....	....	....	....	....	....	....	....	33,248	5,011
32	....	....	570	159	....	....	....	....	....	....	26,571	5,116
33	....	....	....	....	177	60	....	....	....	....	46,467	8,505
34	....	....	....	....	....	....	....	....	....	....	[e]31,703	[e]5,362
35	....	....	....	....	....	....	....	....	....	....	[f]55,950	[f]9,658
36	[d]7,034	[d]1,133	[d]1,815	[d]491	[d]2,247	[d]639	....	....	[d]50	[d]57	348,113	59,671
37	....	....	....	....	....	....	....	....	....	....	4,792	1,338
38	247	79	....	....	441	141	....	....	....	....	6,569	2,169
39	....	....	....	....	....	....	....	....	....	....	960	358
40	....	....	....	....	....	....	....	....	....	....	2,091	796
41	....	....	....	....	....	....	....	....	....	....	6,472	2,534
42	....	....	....	....	....	....	....	....	15	4	3,372	1,079
43	247	79	....	....	441	141	....	....	15	4	21,256	8,274

[e] Includes 4,903 pounds, valued at $1,312 for April, from countries other than United States.

[f] Includes 12,859 pounds, valued at $3,668 for May, from countries other than United States.

It is said by old merchants in San Juan that about twenty years ago much of the butter received from the States was packed in 50-pound tubs.

TABLE 5.—*Exports of butter and oleomargarine from the United States to Porto Rico, 1855–1901.*

Year ended June 30—	Butter.		Oleomargarine.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
1855	93,880	15,889	....	....
1856	116,845	22,298	....	....
1857	128,373	23,440	....	....
1858	140,773	23,519	....	....
1859	212,128	31,126	....	....
1860	186,940	27,317	....	....
1861	188,791	26,396	....	....
1862	239,775	30,898	....	....
1863	276,009	47,766	....	....
1864	(a)	(a)	(a)	(a)
1865	251,705	92,236	....	....
1866	152,420	48,301	....	....
1867	195,497	45,786	....	....
1868	145,765	35,695	....	....
1869	131,317	42,527	....	....
1870	172,291	45,906	....	....
1871	215,891	49,744	....	....
1872	380,480	73,964	....	....
1873	209,938	38,013	....	....
1874	164,455	39,600	....	....
1875	270,864	62,057	....	....
1876	168,884	34,924	....	....
1877	411,583	71,277	....	....
1878	169,620	23,546	....	....
1879	185,893	21,870	....	....
1880	119,416	19,472	....	....
1881	245,646	39,296	....	....
1882	151,450	26,371	....	....
1883	199,449	32,583	....	....
1884	306,332	42,939	....	....
1885	160,535	22,305	....	....
1886	154,072	19,967	180	20
1887	160,346	26,059	50	6
1888	191,038	26,514	12,600	1,627
1889	68,425	10,204	82,429	8,890
1890	108,557	13,711	68,010	8,092
1891	109,210	12,642	59,100	6,648
1892	103,417	13,533	20,700	2,448
1893	63,835	9,780	43,670	5,458
1894	139,774	21,456	76,534	10,182
1895	102,914	12,448	110,515	13,540
1896	20,655	2,754	18,440	1,738
1897	33,525	4,009	....	....
1898	18,900	2,407	....	....
1899	45,706	8,169	204,891	22,903
1900	26,825	5,282	219,140	22,776
1901	247,397	34,170	168,645	15,989

[a] Exports to Porto Rico not reported separately, but with those to "Spanish West Indies."

The statistics of exports since 1886 are of special interest, as in that year the oleomargarine law went into effect and thereafter, if not before, the quantities of butter and oleomargarine exported have been kept separately and probably accurately. Thus statistics are available which the Porto Rican reports of imports do not supply. From them it appears that the shipment of oleomargarine from the States to Porto Rico did not amount to much until 1888, in which year the exports of butter and oleomargarine, respectively, were 191,038 and 12,600 pounds. From that year exports were more or less irregular, but the quantity of butter rapidly decreased and the amount of oleomargarine increased. In 1900 the figures were for butter 26,825 and for oleomargarine 219,140 pounds. About the close of the calendar year 1901 a Porto Rican internal revenue tax of 10 cents per pound was declared upon oleomargarine, and traffic in the article was immediately almost stopped, cheap butter taking its place. In 1901 the quantities of butter and oleomargarine sent from the States to Porto Rico were, respectively, 247,397 and 168,645 pounds.

METHODS OF BUSINESS.

For many reasons—one of the chief of which is the lack of refrigerator facilities in the transportation of butter to Porto Rico and for its storage after arrival—it is necessary to conduct the butter business in a manner very different from the practice in this country.

Small packages are desired which will retain their contents regardless of high temperature or other unfavorable conditions, and tins are generally used. They are packed into cases holding about 100 pounds, with sufficient sawdust, rice hulls, or similar material to keep them from rubbing together. The cases are stenciled with the statement that they are to be kept in a cool place and shipped as ordinary freight. Importations are generally irregular and at long intervals. Some importers and retailers lay in stock enough at one time to last two, three, or even six months. It was noted, however, that an importer of a comparatively high grade brand of Danish butter receives a shipment of about 1,000 pounds regularly every month. Porto Ricans have not become accustomed to the use of ice and it is a scarce and an expensive commodity, as has been stated elsewhere. Therefore ice boxes are not kept in grocery stores, and the butter is held after it arrives in the same way as other canned and bottled goods (Pl. LIV, fig. 1). This would be sufficient explanation, even if there were no other, for the very poor quality of the butter on the market. The fact that butter deteriorates when held in a warm place seems not to be appreciated by those who handle it, though sometimes a merchant would admit that stock which had been on his shelves many months was spoiled. One such person, who kept a store in the country and was a fair representative of many others, offered to the writer a small can of spoiled French butter at an exorbitant price. He explained that it was bad, but it had apparently never occurred to him to reduce the price to hasten the sale of such goods before they were entirely useless. Thus it is shown that the price attached to an article is not necessarily an indication of its quality, though it may have been an indication at a previous time.

PACKAGES.

The higher priced brands of butter which are used almost exclusively by well-to-do families are generally packed in tins holding less than 1 pound, in which the butter can be conveniently allowed to remain until it is used. After being opened and when not on the table these cans are usually kept in the coolest part of the house, which is upon one corner of the filter stone where the temperature is perhaps between 70° and 80° F. (Sometimes the butter is served on the table in small cups, which is the most convenient way of handling such a soft substance.) Cheap butter also arrives in small tins, but most of it is in tins holding about 4½ or about 9 pounds, and sometimes as high as 28 pounds. These larger packages are sold to the few large users, such as hotels, or opened in the stores where their contents are disposed of to the poor in 1 and 2 cent bits.

It is customary for the small cans to be made with convenient opening devices allowing the top to be readily removed by tearing off a narrow strip of tin around the can an eighth or a quarter of an inch from the top by means of a small key which accompanies the can. The larger cans sometimes have the same opening device, and are fitted with wire bails so that they become small pails when opened. It is not usual to find the package lined with any material, as cloth or paraffin paper, or to find its inner surface coated with paraffin.

It is especially noticeable that the European packers are using very attractive looking cans, and they are so well made that a leaky one is seldom seen (Pl. LV, fig. 1). They are finished with various colors of lacquer and with more or less printing and designs upon them. Sometimes paper labels are placed on the tops and bottoms, which are protected by the projecting sides. One shipper of high-grade butter has his name, address, the year of packing, and the words "Pure butter" imprinted in the bottom of the tin. Frequently each package of the best grade of butter is neatly wrapped in paper, and in one case there was found under the wrapper a folded paper on which were statements emphasizing the merits of the butter. An expert tinsmith describes the making of some of the best foreign cans as follows: They are made from 216-pound (to a 20 by 28 box) charcoal tin plate. The side seam is soldered inside and out. The top and bottom are set in and double seamed on without solder, or the top, which is put on before the can is filled, may be fastened with soaking solder. All seams are generous—that is, enough tin to make a good joint. Two partial incisions about one-fourth inch apart extend entirely around the can, the upper one being about one-eighth of an inch from the top. A free end of the narrow strip between these incisions protrudes at the side seam to be attached to the opening key, which is turned back onto the body of the can, tearing the strip off and winding it upon itself. The cover is supported after the removal of the strip by a movable band of tin inside the can and held in place by a swage fitting a corresponding groove around the body of the can. This band is stamped and has a tongue on one end which fits into a slot on the other. Another method of supporting the cover is to have the material from which the sides of the can are to be made folded back upon itself at the line where the top is to be, dropping about one-half inch close to the body, then turned upward again to the top of the can. The partial incisions are in the part extending upward from the last turn and the top is attached to the same. When the strip is removed the top rests upon the first turn.

Most of the American cans seem to be made in the same manner as the best European, except they are not so well made. They have a cheap appearance, and are too often found with grease or salt upon the outside of the seams, showing that they are leaking. Frequently their finish is most unattractive, which is due to poorly applied lacquer, or paper labels attached to the sides or ends which are mutilated and disfigured by hard usage, rust spots, and dirt.

QUALITY AND PRICES.

The color and salt content of the best butter sold in Porto Rico are the same as in the best in the States; but, judged by American standards, no butter of high quality was found on the island, with the exception of two or three brands which have been introduced from the States within the past few months. When good butter is canned and exposed to high temperature for a period of a few weeks or longer, it deteriorates in quality. The best of it has a peculiar flavor which is unpleasant to one accustomed to fresh goods, although it is not objectionable to many who have long been using it and perhaps have never known anything better. It tastes like old butter, but it is quite free from the sharp, rancid flavor which is sometimes found in old butter; frequently it suggests the flavor of old pressed cheese. From this comparatively high quality all grades are found, down to the lowest, which is almost indescribable on account of its repulsive, putrid condition. Goods of intermediate quality are sold in largest quantity. They are, of course, cheaper than the best grades, and this is the chief reason for their selection, though it must be stated that some Porto Ricans actually seem to relish butter with the "high flavor" which is due to a greater or lesser degree of decomposition. They have never had anything different and might not recognize the fresh product of a good creamery as pure butter. There is little doubt, however, that they would very soon show a preference for good butter if it were offered to them at a price which they could afford to pay.

Prices vary widely, the retail extremes being 75 cents and about 16 cents per pound. Frequently several different brands from different countries are sold in the same retail store. The best grades are commonly sold at 50 cents for a can holding about 13 ounces. Most of the butter is sold at 30 to 40 cents per can of a little less than 1 pound, or in 1 or 2 cent bits from larger cans, as has been elsewhere stated (table 6). The tins seldom hold full pounds or half pounds. The shortage in some cases is sufficient to make the actual price much higher than the nominal price. The short weight is intentional on the part of some packers. It is also due to the long-time practice of certain European shippers of packing or claiming to pack only 400 or 200 grams[a] in a tin, and these sizes are freely offered as 1 pound and one-half pound, respectively.

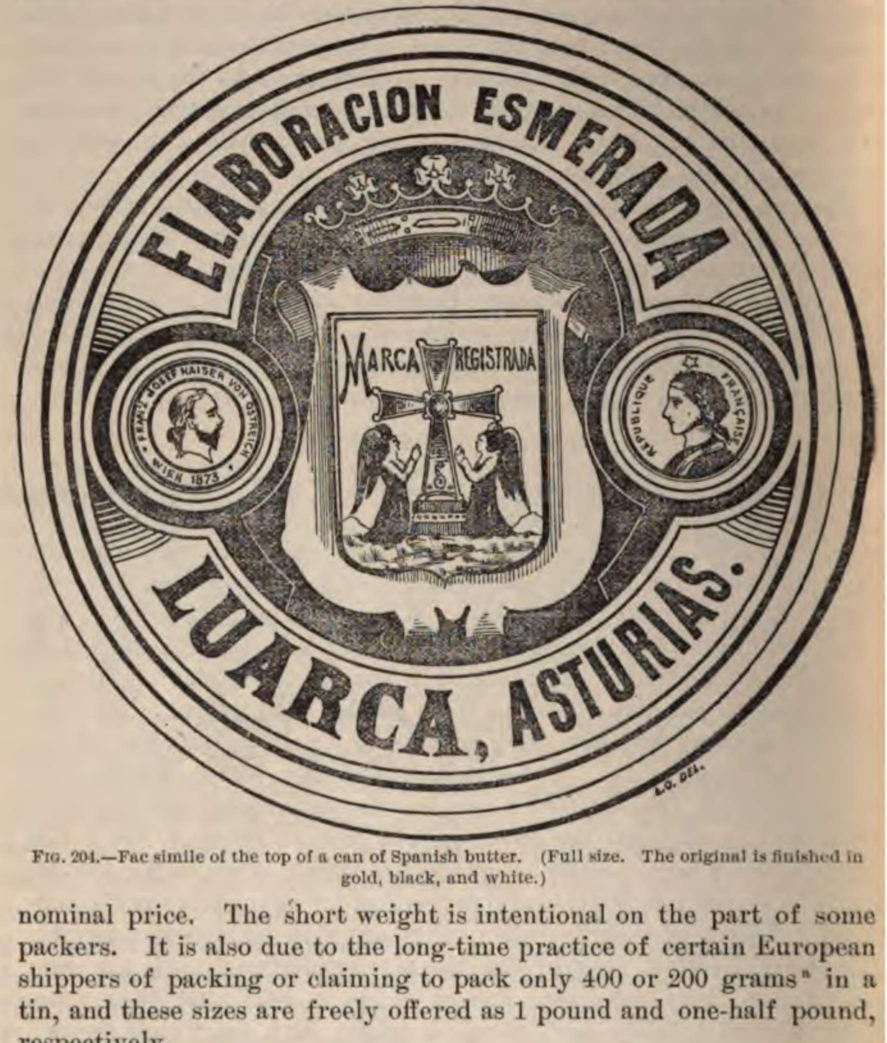


FIG. 204.—Fac simile of the top of a can of Spanish butter. (Full size. The original is finished in gold, black, and white.)

DANISH BUTTER.

With rare exception the best quality of butter has long been supplied from Denmark (Pl. LV, fig. 1). That country has earned an enviable

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[a] 453.6 grams=1 pound.

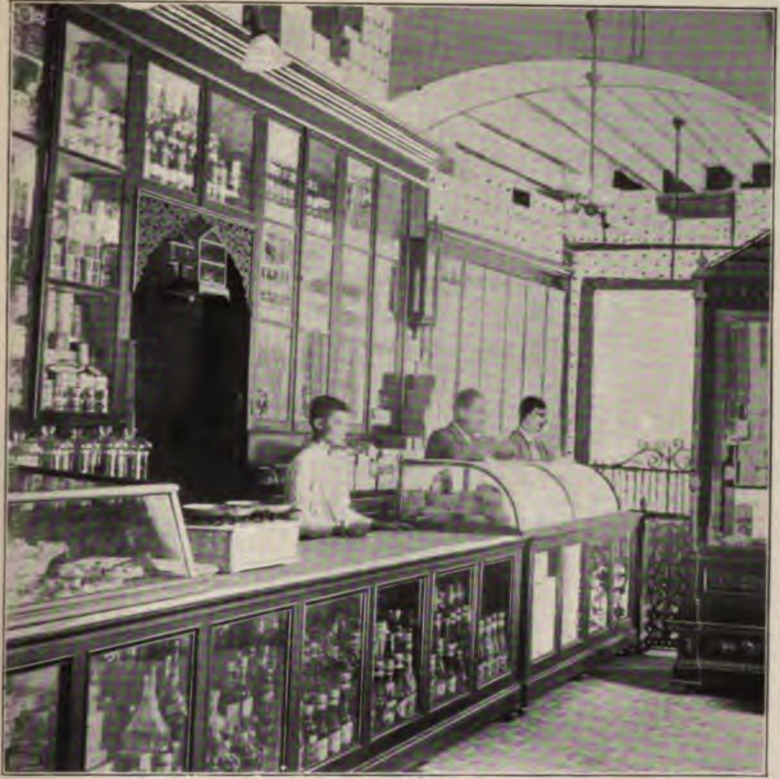

FIG. 1.—INTERIOR OF A GROCERY STORE.

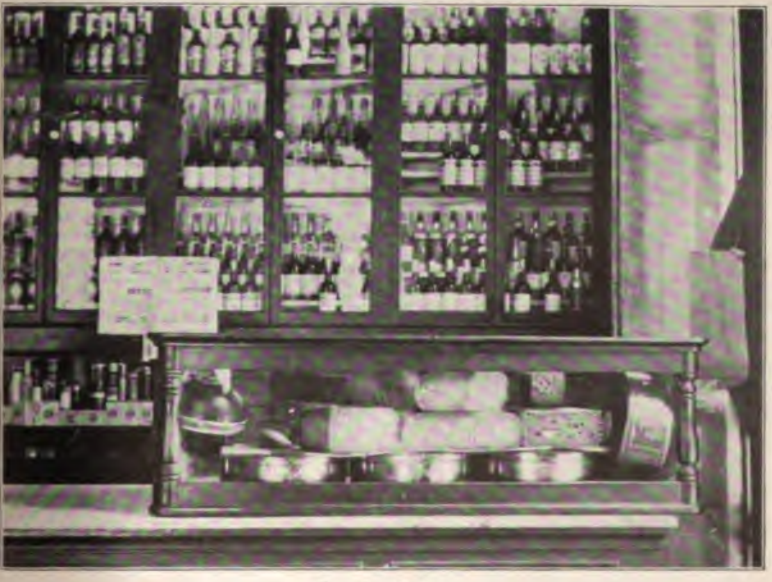

FIG. 2.—SAME.
Showing cheese case filled with imported European brands of cheese.

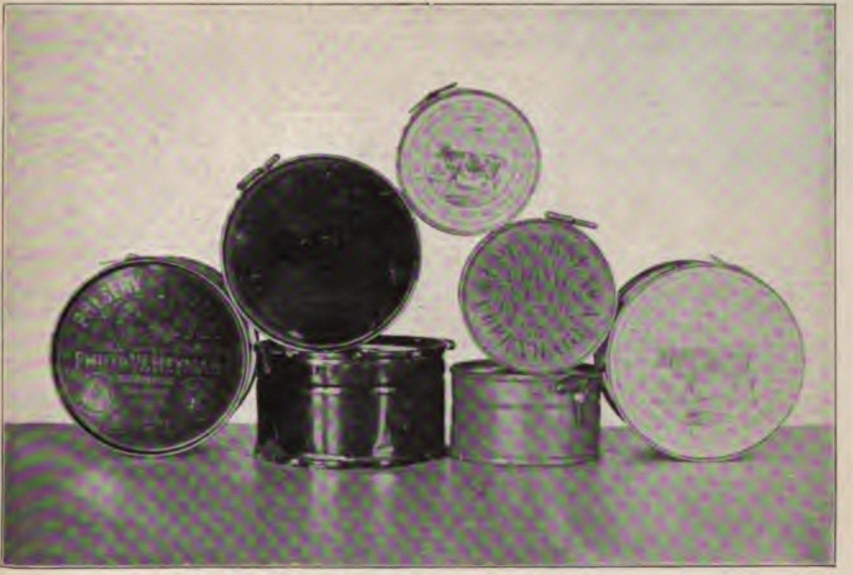

FIG. 1.—DANISH BUTTER IN TINS.

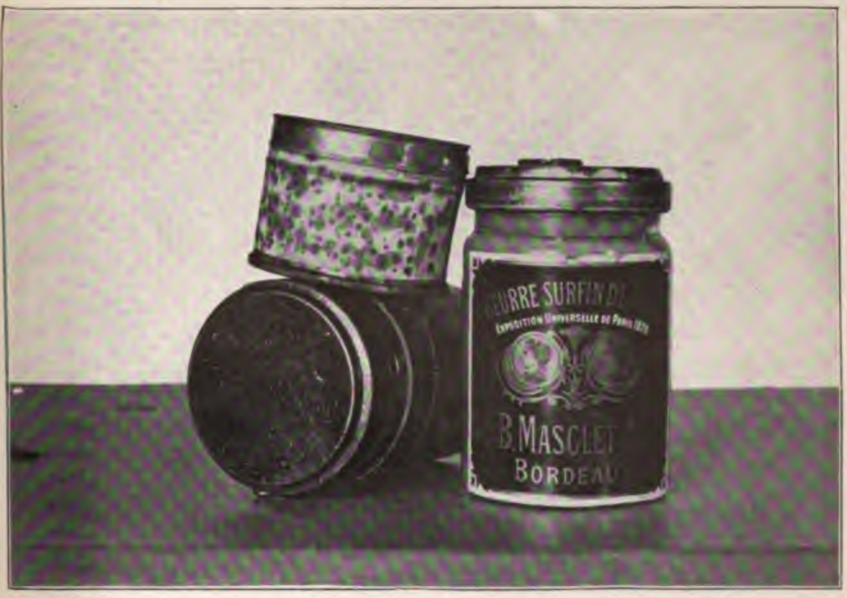

FIG. 2.—FRENCH BUTTER IN GLASS JARS AND A SMALL TIN.

The paper label on the tin is disfigured by rust spots.

utation as the producer of a high-grade butter, which most people ʾorto Rico think can not possibly be improved upon. The quality lifferent Danish brands is quite uniform. The butter is generally ːe or less off in flavor, but there is little doubt that all of it was of h quality when packed. The writer does not recall having seen a of Danish butter so spoiled as to be repulsive, and this can hardly said of any other country's product found on the Porto Rican ·ket. Danish butter (see Nos. 1 to 13, table 6) is always in tins generally of sizes intended to hold 400 or 200 grams, but contain- in fact, a few grams (5 to 7 per cent) less. Chemical analyses w it to be pure, though sometimes its fat content is a little low. cost[a] delivered in San Juan or Ponce varies from 39 to 46 cents

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'he following copy of an invoice of Danish butter received at San Juan shows umerous items of expense connected with its importation:

[Facsimile of label on top of can, including trade-mark, is shown here.]

Cable address, ———.

COPENHAGEN, *the 4th November, 1899.*

oice of 25 cases of Danish butter in tins shipped per ˢ/ₛ. *"Polynesia" to ———, San Juan, Puerto Rico.*

[The weight is only approximate.]

F. o. b. Copenhagen.

Mark.	No.		£	s.	d.
	57	1 case selected qual. à 25 tins à 2 lb., 25 tins, net 50 lbs. @ 15d....	3	2	6
uan	58/59	2 cases selected qual. à 50 tins à 1 lb., 100 tins, net 100 lbs. @ 16½d.	6	17	6
o Rico	60/61	2 cases selected qual. à 100 tins à ½ lb., 200 tins, net 100 lbs. @ 18d.	7	10	0
lamburg	62/71	10 cases selected qual. à 50 tins à 400 gr., 500 tins, net per tin 15d.	31	5	0
	72/73	2 cases selected qual. à 25 tins à 800 gr., 50 tins, net per tin 27d...	5	12	6
	74/81	8 cases selected qual. à 100 tins à 200 gr., 800 tins, net per tin 8¼d..	27	10	0
			81	17	6
		Freight and charges to San Juan	2	3	0
			84	0	6
		Marine insurance to San Juan, £92a $\frac{7}{16}$ per cent..................	......	8	1
			84	8	7

E. & O. E.

Gross weight in kilos, 879. (Signed by) ——— ———.

Number of cases.	Gross weight.		Gross weight of tins.		Inches high.	Inches broad.	Inches long.
	Each case.	25 cases.	Each case.	25 cases.			
1	90		60		5	28¼	28¼
2	94		64		6¾	23¾	23¾
2	91		68		11¼	17⅛	17⅛
10	80		57		5¾	23¾	23¾
2	68		53		4¾	28¼	28¼
8	82	2,052	61	1,488	10⅛	17⅛	17⅛

ιe following statement of another importation of Danish butter was furnished by ιding merchant. It is of especial interest as showing items of expense after per 400-gram tin, which is sold at retail at 45 to 55 cents in the larger cities, 200-gram tins being retailed at 25 to 35 cents. Prices are usually higher in small towns, where very little of this grade of butter is used and where values have not become readjusted since the change of currency.

FRENCH BUTTER.

Little French butter is found in Porto Rico, as is shown by the statistics of imports (Pl. LV, fig. 2). In one of the best stores in San Juan a brand packed in glass jars was on sale at 75 cents per jar, which held a full pound (No. 23, table 6). This butter cost the importer practically 50 cents per pound at his store. Its quality is undoubtedly high. A very poor article of French butter was found in a country store (No. 21, table 6). It was in a small tin, containing less than 7 ounces, and labeled "guaranteed pure." The retail price was 30 cents and the butter was found to contain a preservative.

SPANISH AND ITALIAN BUTTER.

Many tins of butter from Spain and Italy were examined and all found to be very inferior—of such low grade that most Americans would prefer to use no butter at all (figs. 204 [p. 334] and 205 [p. 337]) (see Nos. 31 to 46, table 6). These were generally short weight, low in fat content, and preserved with boric acid. Spanish and Italian butters cost, delivered in Porto Rico and duty paid, 25 to 30 cents per tin containing 12 to 15 ounces. The retail price of such a package is from 30 to 40 cents, and half sizes, 20 cents. Higher prices obtain in

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arrival at San Juan. No explanation is given for the apparent collection of duty on a larger quantity of butter than is shown to have been imported:

PUERTO RICO, *May 9, 1901.*

Invoice, 17 cases of butter, from ——— ———, exporters in Copenhagen, per S.S. "Sardinia."

	£	s.	d.		
1 case, 25 tins of 2 pounds, at 15d. per pound	3	2	6		
8 cases, 400 tins of 400 grams, at 15d. per tin	25	0	0		
8 cases, 800 tins of 200 grams, at 8¼d. per tin	27	10	0		
	55	12	6		
Freight to San Juan and expenses	1	9	0		
	57	1	6		
Maritime insurance (exchange at $4.90)	0	5	6		
	57	7	0		$281.02
Expenses at San Juan:					
Customs declaration form				$0.10	
Lighterage				1.67	
Cartage				1.19	
Duty, 1,004 pounds at 6 cents				60.24	
					63.20
Average cost, at 34¼ cents per pound					344.22

small towns. Much of this butter is in tins holding several pounds, and many are opened in the stores, as has been described. The labels on the tins, referring to quality of contents, are often misleading. A Spanish brand (No. 41, table 6), labeled "The Flower of Asturias, Selected Butter," and selling at retail at 30 cents for 15 ounces, was found to contain a preservative and nearly 30 per cent of water.

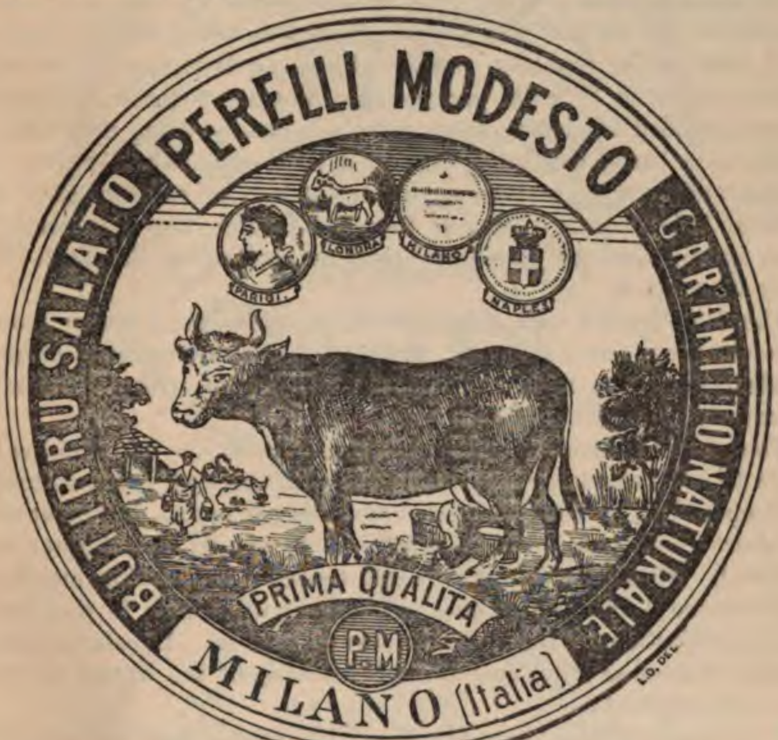

FIG. 205.—Fac simile of a paper label on the top of a can of Italian butter. (Full size.) (White paper, blue ink.)

UNITED STATES BUTTER.

Butter from the States occupies a low position in the markets of Porto Rico. There seems to have been no persistent effort to introduce a good article, and no small effort to sell a poor one. According to a leading New York exporter, it was the practice several years ago to rework and color farm dairy butter and send it to the Tropics, the price being about 10 cents per pound. When the price of this class of butter rose on account of the development of the renovated butter business, oleomargarine was introduced; and, until a few months ago, when that was practically excluded by an internal revenue tax of 10 cents per pound, oleomargarine constituted the bulk of shipments from the States (see table 5). Its quality may be imagined from the fact that much of it was sold at wholesale in Porto Rico for less than 10 cents a pound and at retail for about 14 cents. And, further, the methods followed in its sale may be imagined from the fact that many Porto Ricans now think the term "mantequilla americana" (American butter) means cheap oleomargarine. To them the idea that good butter could come from the United States is absurd. With the exception of very little oleomargarine which is now sold in evasion of the tax law, and probably less upon which the tax has been paid, that article has been replaced by cheap butter, much of which retails as low as 16 cents per pound. Some enterprising exporters have succeeded in getting a low-price product by using very inferior goods as a basis, and incorporating a large quantity of water, salt, casein, and, in some instances, glucose. Chemical analyses show that little of it is what is known as renovated butter, also that preservatives are not commonly used by American packers for this trade (Nos. 61 to 92, table 6).

There was such a wide difference in the character of butter seen at different times under the same brand that it was suspected different grades were being sent out in the same package, which practice has since been admitted by a leading shipper.

The wholesale price of American tinned butter in San Juan varies from 12 to 34 cents per pound.[a] The retail price of different brands is supposed to be between 15 and 45 cents per pound, but on account of short weights they are generally 10 to 20 per cent higher than nominal. Much of this butter is sold through commission merchants who receive it on consignment. Practically all of it is in tins, and a large proportion of the tins hold several pounds. Labels can not be depended upon as truly describing the quality of the butter to which they are attached.

A leading exporting house in New York sends butter to Porto Rico

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[a] The following copy of an invoice of butter imported from the United States shows the different items of expense incurred:

SAN JUAN, P. R.

Invoice of shipment of American butter, 5 cases of 16 2-lb. packages —— brand.

Total, 160 pounds, at 39 cents		$62.40
Freight, extra 5 per cent	$2.30	
Insurance policy	.89	
Notary fee	.20	
		3.39
		65.79
Commission, 2½ per cent		1.64
		67.43
3 months' interest at 6 per cent per annum		1.00
Exchange in New York, ½ per cent		.34
		68.77
Expenses at San Juan, P. R.:		
Entry blanks and revenue charges		.10
Lighterage		.15
Cartage		.30
Duty, 160 pounds, at 6 cents, $9.60—15 per cent		1.44
		70.76

(Average cost at $0.88½ per jar of 2 pounds.)

in small neatly decorated tins, marked "Fancy Table Butter" (No. 65, table 6), and bearing the picture of an eagle. A can containing 15½ ounces of this butter retailed in San Juan for 30 cents, the wholesale price being 21 cents. It was found to contain practically 8 per cent

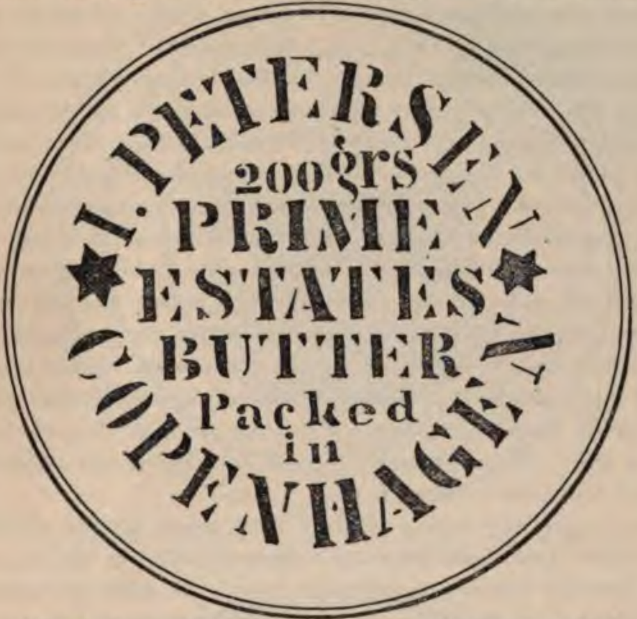

FIG. 206.—Fac simile of the top of a can of Danish butter. (Full size.)
(Tin is yellow; letters are black.)

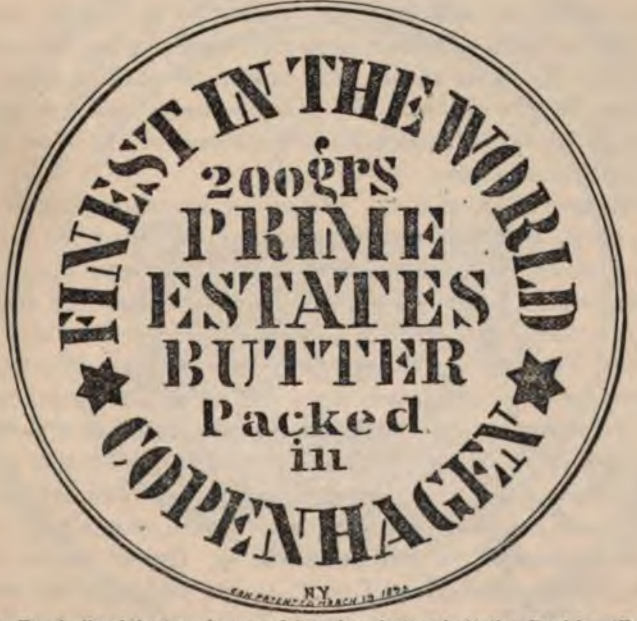

FIG. 207.—Fac simile of the top of a can of American butter, imitating Danish. (Full size.)
(Tin is yellow; letters are black.)

of glucose, which, with an excess of water and salt, left less than 69 per cent of fat. The same concern furnishes a better quality of butter in small tins which are made to imitate closely a well-known brand of Danish butter (figs. 206 and 207). It is labeled "Finest in the World, 200 grams, Prime Estates Butter, Packed in Copenhagen, N. Y.," but the letters "N. Y." are very inconspicuous, and when the attention of one storekeeper was called to them, it was amusing to hear him insist that they stood for Denmark! The tin contained only 172 grams, or 6 ounces of butter. A merchant who handled a considerable quantity of this brand admitted that the chief reason for its sale was that most purchasers supposed it to be from Denmark; he himself never used it, but purchased, at a higher price, Danish butter for his table. Its quality was much inferior to the best butter on the market, though it was better than most other American butters in his market, and chemical analysis showed that it contained no adulterant. It cost in New York 28 cents per (short) 400-gram tin and 16 cents per (short) 200-gram tin. These are sold for 40 and 20 cents, respectively, in Ponce and for more in small towns.

Another exporting house in New York sends butter to Porto Rico in tins which hold less than 5½ ounces (No. 76, table 6), and which retail in interior towns as high as 20 cents. A different brand is sent in tins holding 177 grams, or 6¼ ounces, which retails in small towns as high as 30 cents (No. 74, table 6). The same ambitious concern sends out butter in pails holding from 4 to 5 pounds, and labeled "Pure Yellow Goshen Butter, Superior Quality, La Favorita" (No. 78, table 6). Analysis shows this butter to contain about 10½ per cent glucose, 8½ per cent ash, 18½ per cent water, and less than 62 per cent fat. It is sold at wholesale in San Juan for 16½ cents per pound and at retail for 25 cents.

Some packers think that the picture of a cow on a tin of butter is necessary to its sale, and certain ones have adopted for this purpose an exact copy of the picture of a Danish cow appearing on brands already successfully introduced from Denmark (figs. 208 and 209).

A large number of circulars were found which had been sent out from a New York house to advertise two brands of butter. As is usual when previous shipments have not been creditable, emphasis is laid on such statements as "lately the quality of these brands has been greatly improved." They are guaranteed to be absolutely pure. One brand, said to contain "a little salt" and to be suited for middle-class customers, was found by analysis to contain 8.26 per cent of ash and only 74.44 per cent of fat (No. 84, table 6). Quotations on these butters were, in March, in New York City, 21 and 21½ cents per pound tin, or 4 cents less in 5-pound tins. The latter were retailed in San Juan at 30 cents per pound, the retailer stating that he paid 26 cents. Some merchants said these brands were not fit even for cooking.

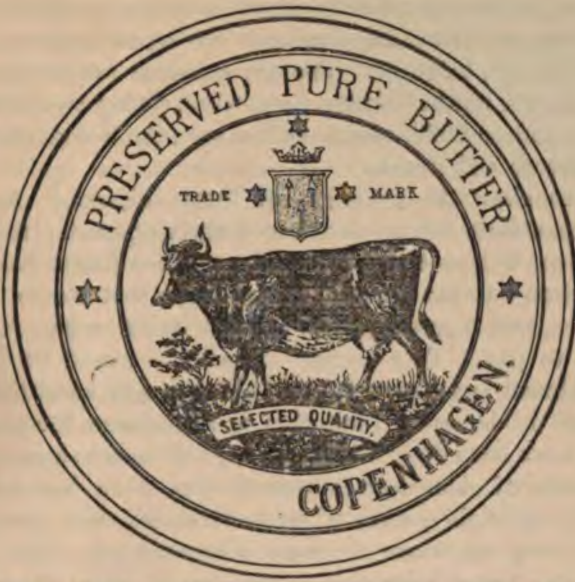

FIG. 208.—Fac simile of top of a can of Danish butter. (Reduced size.) (White paper, blue ink.) (Name of packer omitted.)

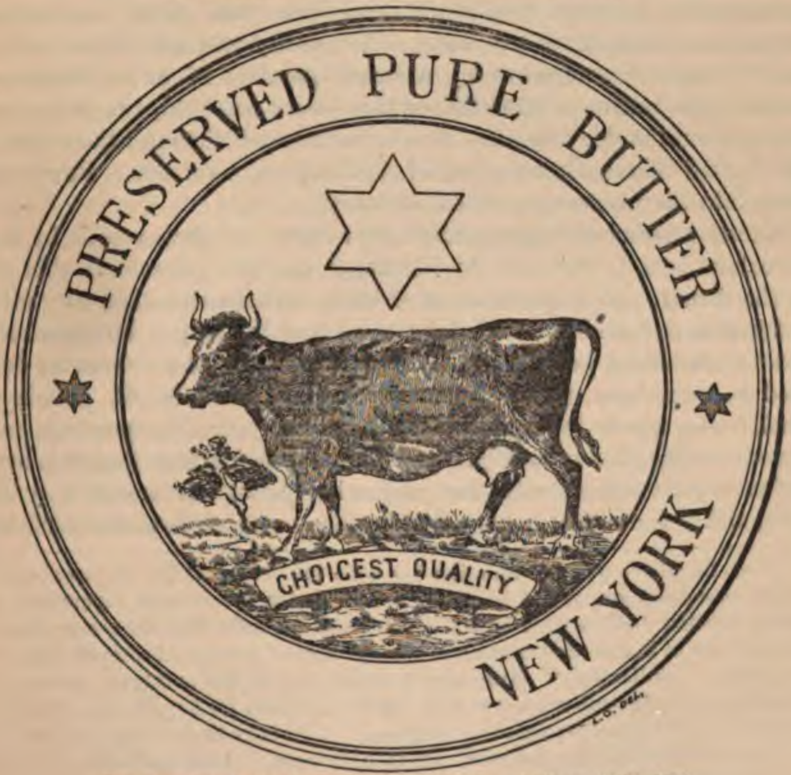

FIG. 209.—Fac simile of top of a can of American butter. (Full size.) (White paper, blue ink.) (Name of packer omitted.)

A so-called American creamery company sells a product described on the package as "Pure Butter," and having the picture of an eagle displayed (No. 79, table 6). The tin contains about 4 pounds of a substance that is neither butter nor cheese, being two-fifths fat, two-fifths water, and one-fifth casein, sugar, etc., the last consisting largely of added glucose and starch.

Enough to show the practices of some shippers! As the goods described constitute a large portion of the shipments from the States to Porto Rico, it is not strange that American butter has an unenviable reputation on that island. Some argue that Porto Ricans want cheap butter, and a good article can not be furnished for what they are willing to pay. To a certain extent this would be true for any section of almost any country, and it is willingly admitted that much cheap butter is demanded, but this is no defense for such business methods as have been described, bringing dishonor to a great industry.[a]

Two brands of American butter in tins were found which were undoubtedly of high quality when packed, but had deteriorated on account of long exposure to high temperatures. One was in the United States Army Subsistence Department (No. 61, table 6), and was sold to the few civilians who were permitted to buy at 44 cents per pound. Another was found in a San Juan store, having been imported a long time previous. Its quality was not high, but had been preserved somewhat by a small quantity of brine which surrounded the butter. But little of this brand was sold, the price being 5 or 10 cents under Danish. It was introduced through the efforts of the United States Department of Agriculture soon after Porto Rico came into the possession of this country.

Another brand of high-grade butter from the States, sold in white porcelain jars, is referred to elsewhere (p. 360.) Some of this goes to the Army, and it seems to give better satisfaction than any other, but it also is found to deteriorate when held too long. It is packed in jars which hold 2 pounds and cost in New York 73 to 80 cents; delivered in San Juan, 81 to 88 cents, retailing there for $1, and in one small town where it was found at $1.25 per jar. The package is an expensive one, heavy and bulky. The merchants handling this brand claim it has a better body than any other American brand they have seen, and is far superior in quality to the numerous brands which have been offered to them. Some think it has not as good body as the Danish, and say it "goes to pieces" in the hottest weather unless kept on ice. Soon after the writer's arrival in San Juan good butter was placed on sale by an American meat company that controls the only commercial refrigerator between New York and Porto Rico and operates refrigerating plants in San Juan and Ponce. This concern received a shipment every fourth week. They had previously sold oleomargarine, but that was discontinued when the 10-cent revenue tax was imposed. Their butter was in 1-pound prints, wrapped in parchment paper, and sold at 30 cents per pound wholesale and 40 cents retail. In their refrigerator facilities this concern has an advantage over all others.

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[a] Since the above was written a law has gone into effect which requires butter of certain described grades and kinds to be made under government supervision and plainly labeled "adulterated butter." This will hereafter include compounds and preparations of butter such as some of those described above and compel them to be designated "adulterated." Attention is called also to the authority given to the Department of Agriculture to examine butter intended for export, and this is now being done whenever requested by shippers. All butter thus examined and found of high quality is plainly marked by official certificates. Application for certification should be made to the Department of Agriculture by persons exporting.

A favored few prominent residents of San Juan obtain their butter supply through the stewards of ships from New York. This is only by private arrangement.

Prior to the writer's visit to Porto Rico, a few small lots of selected butter were sent there by this Department for trial, but not with much success. The Spanish merchants receiving them did not know how to handle the butter, and it was allowed to deteriorate while in their hands. A little of it was in 5-pound boxes, which were handled in a unique way. They were stored on a shelf in the store, where the temperature was often above 80° F., and one box at a time was removed to a small ice chest for use as the butter was needed for sale. It was supposed that if the butter was cold and hard when sold, nothing more could be desired, and that no harm could come to it if allowed to stand in a warm place so long as the boxes were not opened. While the butter sent from the Department was fresh it was readily sold at 40 cents per pound, which was very satisfactory, considering the difficulty of introducing any new brand.

Samples of numerous brands of butter were purchased in the open markets of Porto Rico and sent to the Department for examination. Most of them were analyzed by G. E. Patrick, dairy chemist of the Bureau of Animal Industry. The labels on the packages, size of packages, prices paid, chemical composition, etc., are shown in the accompanying table. A few butters purchased in St. Thomas and Cuba and treated in the same manner are included here for purposes of comparison (table 6).

TABLE 6.—*Butter sold in Porto Rico, St. Thomas,*

Original No.	Laboratory No.	Origin.	Description of package.	Marks on package referring to quality.	Claimed weight of contents.	Retail price of package.	Place of purchase.	Original No.
						Cts.		
1	22748	Denmark	Tin, pale yellow...	Preserved pure butter	....	35	Catania, P. R ..	1
2	22749	....do...	Tin, amber lacquer	Preserved pure butter; selected quality.	....	55	San Juan, P. R.	2
3	22750	....do...	.....do............	Choicest selected butter; guaranteed pure.	200 grams, net.	25	Santiago, Cuba	3
4	22751	....do...	Tin, yellow paint..	Prime Estates butter..	200 grams..	40	Near Cayey, P. R	4
5	......	....do...	.....do............	Prime Estates butter (oleomargarine).	.....do.....	40	Habana, Cuba .	5
6	22752	....do...	.....do............	Prime Estates butter..	½ pound....	35	San Juan, P. R.	6
7	22753	....do...	Tin, red, gold trimmed.	Preserved butter.....	....	50	Ponee, P. R	7
8	......	....do...	Tin, yellow amber.	Preserved pure butter	(1 pound?).	45	St. Thomas	8
9	22754	....do...	.....do............	Preserved pure butter; selected butter of choicest quality.	....	....	.....do........	9
10	22755	....do...	Tin, light purple...	Selected butter; choicest quality.	Full weight	30	Cienfuegos, Cuba.	10
11	22756	....do...	Tin, yellow amber.	Selected quality; preserved pure butter.	....	40	.....do........	11
12	22757	....do...	.....do............	.....do..............	....	....	Santiago, Cuba	12
13	22758	....do...	Tin, light-yellow amber.	.....do..............	....	35	Habana, Cuba .	13
21	22759	France .	Tin, plain	Butter, guaranteed pure. (French.)	....	30	Salinas, P. R...	21
22	......	....do...	Glass jar..........	Superfine table butter. (French.)	(1 pound?).	75	San Juan, P. R.	22
23	22760	....do...	.....do............	.....do..............	.....do.....	75	.....do........	23
31	22761	Italy....	Tin, wine color....	Butter from pure milk for family use, especially for export. Excelsior. (Spanish.)	....	25	.....do........	31
32	22762	....do...	.....do............	.....do..............	....	35	.....do........	32
33	......	....do...	.....do............	.....do..............	(1 pound?).	40	.....do........	33
34	22763	....do...	Tin, light wine color.	Selected butter; natural color; prime quality. (Italian.)	....	50	Manati, P. R...	34
35	22764	....do...	Tin, dark purple...	Finest selected Lombardy butter.	....	20	San Juan, P. R.	35
36	......	....do...	.....do............	.....do..............	(½ pound?).	20	.....do........	36

NOTE.—For footnotes, see pages 350 and 351.

and Cuba—packages, prices, analyses, etc.

Original No.	Weight of contents of package.	Weight of package and contents.	Weight of free brine.	Weight of empty package.	Use of linings in package.	Chemical analysis.[a]					On the fats.	
						Water.	Fat.	Casein, sugar, etc.	Ash.	True casein (N × 6.25).	Degrees, butyro-refractometer, calc. to 25° C.	Volatile acids (Reichert-Meissl number).
	Ozs.[b]	*Gms.*[b]	*Gms.*[b]	*Gms.*[b]		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		
1	6.90	281.5	2.0	85.5	None	12.04	84.27	1.37	2.32	......	51.8	.....
2	13.58	512.0	10.0	126.3	Cheese cloth on top.	11.72	83.54	1.13	3.61	......	51.0	.....
3	6.87	278.5	9.0	83.3	Paper on top and bottom.	13.34	82.53	1.10	3.03	......	52.0	.....
4	6.85	275.0	0.0	80.3	None	12.62	83.09	1.54	2.75	......	51.3	.....
5	......	......	......	......	......	......	......	......	......	......	......	.....
6	7.41	291.0	14.0	80.5	None	15.02	81.16	1.32	2.50	......	51.6	.....
7	13.86	520.0	11.0	126.3	Cloth on top and bottom.	13.12	84.07	1.10	1.71	......	51.4	.....
8	......	......	......	......	......	......	......	......	......	......	......	.....
9	13.48	505.5	22.0	122.5	None	15.48	79.39	1.52	3.61	......	51.9	.....
10	7.88	318.0	0.0	94.0	.....do	12.79	81.70	1.68	3.83	......	51.2	.....
11	6.76	268.2	15.7	76.0	Cloth on top	12.06	83.42	1.00	3.52 [e]3.34	......	51.7	.....
12	7.27	289.0	9.0	82.5	Cloth on top and bottom.	12.90	78.08	1.52	7.50 [e]7.31	......	51.5	.....
13	7.33	278.2	9.0	70.0	.....do	12.56	83.87	1.77	1.80	......	51.6	.....
21	6.81	266.0	.2	72.5	None	11.06	83.06	1.92	[d]3.96	......	49.5	.....
22	......	......	......	......	......	......	......	......	......	......	......	.....
23	16.51	733.0	11.0	254.0	Tin foil and paper on top.	12.22	82.08	1.60	4.10	......	49.9	.....
31	5.73	226.0	4.5	63.0	Paper on top and bottom.	15.50	81.78	1.12	[d]1.60	......	50.3	.....
32	12.21	458.8	1.5	111.0	Cloth on top	17.32	78.28	1.60	2.80	......	51.6	.....
33	......	......	......	......	......	......	......	......	......	......	......	.....
34	12.28	468.0	0.0	119.0	None	16.76	78.14	1.78	[d]3.32	......	50.1	.....
35	7.90	299.0	0.0	64.5	Cloth on top and bottom.	13.70	82.20	1.56	[d]2.54	......	51.5	.....
36	......	......	......	......	......	......	......	......	......	......	......	.....

NOTE.—For footnotes, see pages 350 and 351.

TABLE 6.—*Butter sold in Porto Rico, St. Thomas,*

Original No.	Laboratory No.	Origin.	Description of package.	Marks on package referring to quality.	Claimed weight of contents.	Retail price of package.	Place of purchase.	Original No.
						Cts.		
41	22765	Spain	Tin, pale lemon, fancy label on side, picture and red border on top.	The flower of the Asturias; selected butter. (Spanish.)		30	San Juan, P. R.	41
42		....do	....do	....do	(1 pound?).	30	....do	42
43	22766	....do	Tin, top red, black, and green; sides ditto and lemon.	Selected butter. (Spanish.)		35	Cayey, P. R	43
44	22767	....do	Tin, red, gilt letters, black trimming.	Selected A1 butter. (Spanish.)		35	Habana, Cuba	44
45	22768	....do	Tin, silver, bronze trimming, black letters.	Genuine cow's butter. (Spanish.)		30	San Juan, P. R.	45
46	22769	....do	Tin, ditto, and red and yellow stripes on side.	Selected butter		25	....do	46
51	22770	Netherlands.	Tin, gray, blue trimming, red and silver letters.	Guaranteed pure cream butter.		*75	Habana, Cuba	51
52	22771	Canada	Tin, red, gilt letters	Extra finest Canadian butter.		*30	Manzanillo, Cuba.	52
53	22772	....do	(Bottle, small sample from broken package.)			*32	St. Thomas	53
54	22773	Porto Rico.	....do				Porto Rico	54
55	22774	....do	....do					55
56	22775	Cuba	....do			*50	Manzanillo, Cuba.	56
61	22776	United States.	Tin, plain, paper label.	Creamery butter in tins.	1 pound	44	San Juan, P. R.	61
62	22777	....do	Tin (bulky), paper label.	Creamery butter from pure cream.	....do	50	....do	62
63	22778	....do	Tin, thin amber	Selected butter	1 pound, net.	...	....do	63
64	22779	....do	Tin, bronze top, red label.	Celebrated table butter.		25	Santiago, Cuba	64
65	22780	....do	Tin, red, gilt letters	Fancy table butter		30	San Juan, P. R.	65
66	23678	....do	....do	....do		30	....do	66

NOTE.—For footnotes, see pages 350 and 351.

and Cuba—packages, prices, analyses, etc.—Continued.

Original No.	Weight of contents of package.	Weight of package and contents.	Weight of free brine.	Weight of empty package.	Use of linings in package.	Chemical analysis.[a]						
						Water.	Fat.	Casein, sugar, etc.	Ash.	True casein (N×6.25).	On the fats.	
											Degrees, butyro-refractometer, calc. to 25° C.	Volatile acids (Reichert-Meissl number).
	Ozs.[b]	*Gms.*[b]	*Gms.*[b]	*Gms.*[b]		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		
41	14.98	524.0	0.0	98.5	Cloth on top......	29.62	64.86	1.52	[d]4.00	......	49.7	.....
42	......	....	......	......	....	......	......	....	....	......	......	.....
43	13.87	474.0	4.0	80.0	Cloth on top and bottom.	14.96	80.48	1.18	3.38	......	50.9	.....
44	12.60	450.0	0.0	92.0	Cloth on top......	13.71	82.15	1.66	[d]2.48	......	45.9	27.9
45	13.82	476.5	0.0	84.0	Cloth on top and bottom.	15.14	80.94	1.78	2.14	......	49.3	26.9
46	13.08	488.0	0.0	116.5	.....do	17.62	80.22	1.08	1.08 [e].92	.....	51.4	.....
51	15.89	575.5	0.0	124.0	Paper on top and bottom.	14.18	83.50	1.32	[d]1.00	......	53.7	28.0
52	7.30	286.5	0.0	79.0	None	12.67	81.96	1.27	4.10	......	51.2	.....
53	......	....	......	......	Broken package..	9.91	82.33	2.23	5.52 [e]5.32	0.70	51.6	.....
54	4.14	....	Much	......	.....do	[f]64.7	[f]27.9	[f]2.8	[f]4.6	......	......	.....
55	......	....	......	......	.....do	37.50	59.70	1.05	1.75	......	51.4	.....
56	......	....	......	......	.....do	20.89	75.98	1.16	1.97	......	51.3	.....
61	15.82	558.5	21.0	109.0	None	13.88	81.28	.98	3.86	......	52.7	27.8
62	24.33	885.0	[a]232.0	194.0	Paraffin on top; butter wrapped in paper and surrounded by brine.	[a]9.48	87.48	1.00	2.04	......	51.2	.....
63	15.00	535.0	1.0	109.0	None	9.20	88.06	1.62	1.12	......	50.1	.....
64	15.35	554.0	4.5	118.0	.....do	22.58	55.72	7.81 [g]7.00	13.89 [e]13.73	.47	51.1	.....
65	15.42	541.0	1.5	103.0	.....do	17.45	68.38	8.80 [g]7.90	5.37 [e]5.08	.62	48.3	26.7
66	......	....	......	......	....	17.02	74.37	3.44 [h]2.71	5.17	......	......	.....

NOTE.—For footnotes, see pages 350 and 351.

TABLE 6.—*Butter sold in Porto Rico, St. Thomas,*

Original No.	Laboratory No.	Origin.	Description of package.	Marks on package referring to quality.	Claimed weight of contents.	Retail price of package. Cts.	Place of purchase.	Original No.
67	22781	United States.	Tin, yellow paint, black letters.	Finest in the world; Prime Estates.	200 grams	25	Near Ponce, P. R.	67
68	22782	do	Tin, bronze, paper label on top.	Preserved pure butter; choicest quality.	¼ pound		San Juan, P. R.	68
69	22783	do	do	do	do	20	Santiago, Cuba	69
70		do	do	do	do		do	70
71		do	do	do	do		do	71
72	22784	do	do	do	do		San Juan, P. R.	72
73	22785	do	do	do	do		do	73
74	22786	do	Tin, tapering, bronze.	do		30	Salinas, P. R.	74
75	22787	do	Tin, bronze, paper label on top.	do		40	San Juan, P. R.	75
76	22788	do	Tin, bronze	do		20	Caguas, P. R.	76
77	22789	do	do	Pure yellow Goshen butter; superior quality.		20	Santiago, Cuba	77
78	22790	do	Tin pail, bronze, large red label on side.	do		113	San Juan, P. R.	78
79	22791	do	do	Pure butter. (Spanish.)		125	do	79
80	22792	do	Tin, bronze, blue-paper label.	Creamery butter		40	Guayama, P. R.	80
81	22793	do	Tin, bronze, red label.	Superior Goshen butter.		137	Sta. Isabel, P. R.	81
82	22794	do	Tin, bronze, pink top.	Fine butter. (Spanish.)		35	Santiago, Cuba	82
83	22795	do	do	do			San Juan, P. R.	83
84	22796	do	Tin, bronze, light-gray top, red and blue letters.	A pure butter of superior quality.			do	84
85		do	do	do			do	85
86	22797	do	Tin, bronze, paper label on top.	Preserved pure American butter; selected quality.			Habana, Cuba	86
87	22798	do	Tin, red and gold	Cream butter of first quality for families. (Spanish.)			San Juan, P. R.	87
88	22799	do	Tin pail, bronze, big red and blue label on side.	Oleomargarine		60	Santiago, Cuba	88

NOTE.—For footnotes, see pages 350 and 351.

and Cuba—packages, prices, analyses, etc.—Continued.

Original No.	Weight of contents of package.	Weight of package and contents.	Weight of free brine.	Weight of empty package.	Use of linings in package.	Chemical analysis.[a]						
						Water.	Fat.	Casein, sugar, etc.	Ash.	True casein (N × 6.25).	On the fats.	
											Degrees, butyro-refractometer, calc. to 25° C.	Volatile acids (Reichert-Meissl number).
	Ozs.[b]	*Gms.*[b]	*Gms.*[b]	*Gms.*[b]		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		
67	6.00	239.0	6.0	67.0	None	10.93	85.98	.95	2.14	......	51.3	.....
68	6.16	244.5	1.5	69.5	....do	11.10	85.65	1.26	1.99	......	51.7	.....
69	6.49	254.5	1.5	70.0	....do	12.87	83.99	.78	2.36	......	51.3	.....
70	......	......	......	......	......	......	......	......	......	......	......	.....
71	......	......	......	......	......	......	......	......	......	......	......	.....
72	6.02	240.0	0.0	69.0	None	7.32	90.02	.74	1.92	......	51.8	.....
73	14.22	514.5	4.5	110.5	....do	7.42	88.90	1.04	2.64	......	51.8	.....
74	6.23	244.0	0.0	67.0	....do	13.32	83.58	1.04	2.06	......	52.9	26.2
75	12.23	451.5	2.0	104.0	Paper on top	15.06	80.52	1.40	3.02	......	51.0	.....
76	5.31	217.0	0.0	66.0	None	10.62	85.61	1.58	2.19	......	52.4	.....
77	7.67	298.0	0.0	80.0	....do	23.02	60.44	9.34 [b]8.50	7.20 [c]7.08	.55	48.1	28.2
78	70.36	2,252.0	0.0	253.5	....do	18.33	61.64	11.45 [b]10.60	8.58 [c]8.30	.53	50.2	.....
79	70.00	2,233.0	[a]90.0	245.0	....do	[a]27.19	40.36	19.80 [b]15.50 [d]3.15	12.65 [c]12.09	.86	50.7	.....
80	15.17	525.0	0.0	94.0	....do	11.88	82.22	1.88	4.02	......	51.0	.....
81	60.63	1,932.0	28.0	210.0	....do	11.66	83.06	1.48	3.80	......	51.0	.....
82	16.51	545.0	11.0	76.0	Cloth on top and bottom.	11.96	84.68	1.04	2.32	......	52.5	30.5
83	6.95	271.5	1.0	74.0	Cloth on bottom	13.46	83.82	1.20	1.52	......	52.9	25.5
84	7.27	280.5	0.0	74.0	Cloth on top and bottom.	15.48	74.44	1.82	8.26	......	51.3	.....
85	......	......	......	......	......	......	......	......	......	......	......	.....
86	7.42	287.0	0.0	76.0	None	12.96	80.14	3.16 [b]2.20	3.74	0.68	51.5	.....
87	13.66	494.0	0.0	106.0	....do	13.82	82.03	1.60	2.55	......	51.9	.....
88	66.18	2,073.0	2.0	250.0	Paper on top and bottom.	11.24	[b]79.60	1.20	7.96	......	58.4	3.2

NOTE.—For footnotes, see pages 350 and 351.

TABLE 6.—*Butter sold in Porto Rico, St. Thomas,*

Original No.	Laboratory No.	Origin.	Description of package.	Mark on package referring to quality.	Claimed weight of contents.	Retail price of package.	Place of purchase.	Original No.
						Cts.		
89	22800	United States.	Small sample from broken package.	....	....	[e]60	Habana, Cuba	89
90	22801	....do	....do	....	....	....	Santiago, Cuba	90
91	22802	....do	....do	....	....	....	Habana, Cuba	91
92	22803	....do.[m]	....do	....	....	[e]20	Ponce, P. R	92

[a] The analyses were made upon the entire contents of the cans, i. e., the butter and free brine combined, except with Nos. 62 and 79, where the amount of free brine was large.

[b] 1 ounce = 28.35 grams; 1 pound = 453.6 grams; 100 grams = 3.53 ounces, or 0.22 pound.

[c] Sodium chloride.

[d] Boric acid.

[e] Per pound.

[f] This sample was accidentally overturned and spilled (in a wooden tray) after having been melted and shaken preparatory to analysis. It was immediately recovered, apparently without material loss of one constituent more than another, and analyzed in duplicate. The figures are believed to represent very closely the composition of the sample before the accident, but because of the accident the analysis is reported merely as an approximate one. A remarkable property of this sample, due to its enormous amount of water, was observed in preparing it for analysis, i. e., while shaking and cooling, after having melted it, it did not reassume the appearance of butter, but remained a watery or milky liquid, containing suspended particles of butter. Before the treatment no extraordinary amount of free brine had been observed. This behavior of the sample suggests the so-called butter produced by one of the butter increasers, such as "black pepsin."

and Cuba—packages, prices, analyses, etc.—Continued.

Original No.	Weight of contents of package.	Weight of package and contents.	Weight of free brine.	Weight of empty package.	Use of linings in package.	Chemical analysis.[a]						
											On the fats.	
						Water.	Fat.	Casein, sugar, etc.	Ash.	True casein (N × 6.25).	Degrees, butyro-refractometer, calc. to 25° C.	Volatile acids (Reichert-Meissl number).
	Ozs.[h]	*Gms.*[h]	*Gms.*[h]	*Gms.*[h]		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		
89	......	....	......	......	Broken package..	11.02	85.93	1.02	2.03	......	50.5	.....
90	......	....	......	......	.....do............	12.42	84.37	1.06	2.15	......	51.3	.....
91	......	....	......	......	.....do............	10.13	[k]86.54	1.23	2.10	......	55.7	2.1
92	......	....	......	......	.....do............	12.82	82.61	.84	3.73	......	50.9	.....

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[g] "Glucose." It apparently includes 1 to 1.3 per cent of cane sugar, probably added with the glucose.

[h] Glucose.

[i] Starch.

[k] Oleomargarine.

[l] One-half pound.

[m] For butters introduced by Department of Agriculture, see pages 357-359.

EXPERIMENTAL SHIPMENTS OF BUTTER FORWARDED BY THE UNITED STATES DEPARTMENT OF AGRICULTURE TO PORTO RICO.

While the writer was in Porto Rico several small shipments of the best butter obtainable were forwarded to him for the purpose of showing exactly what were the transportation facilities and in what condition such butter would reach its destination, also to assist in forming an opinion as to the opportunity to develop a trade in this kind of goods. Definite and satisfactory information was obtained along these lines.

At this point it is proper to acknowledge with thanks the many courtesies of Governor Allen; Hon. G. W. Whitehead, collector of customs; Colonel Buchanan, Major Swift, and other officers of the Army; Mr. Herbert G. Ogden, and other officers of the United States Coast and Geodetic Survey; Mr. Butler, agent of the New York and Porto Rico Steamship Line; Messrs. Boulton, Bliss, and Daggett, New York agents of the Red "D" Line; Mr. H. G. Guimaraes, vice-president of the San Juan Ice Company, and others, who were interested in the success of the efforts of this Department and gladly assisted in every possible way.

TRANSPORTATION FACILITIES.

The only regular service between the United States and Porto Rico (at the close of the year 1901) is from New York City to San Juan. The ships of two lines sail on alternate Saturdays, and about five days are required for the voyage. The steamers of one line make only a short stop at San Juan, where the part of the cargo for Porto Rico is removed with the aid of lighters; thence they proceed to South American ports. The steamers of the other line, after stopping two or three days at San Juan, where they have the use of a large covered pier, go to Ponce, and sometimes call at other ports. This line also runs small coasters from San Juan to all island ports about every week.

There are irregular sailings between the States and several different Porto Rican ports, but it would be impracticable to take advantage of them for shipping dairy products.

FREIGHT RATES.

The freight rate on butter from New York to San Juan or Ponce is 12 cents per cubic foot of space occupied, regardless of how heavy the package may be, and there is a minimum charge of $3.

LACK OF REFRIGERATOR FACILITIES.

Only one ship, which leaves New York every fourth week, is equipped with a commercial refrigerator, and that is sublet to a meat company, hence is not available to forwarders of dairy products.

Each ship has refrigerators for its own table supplies, but it is not practicable to put freight into them. Failure to provide properly for carrying perishable products is due to the fact that there is little demand for this kind of service. Quantities of food products are included in every south-bound cargo, but they consist of such articles as flour, rice, hams, codfish, lard, and bottled and canned goods, which are supposed to keep almost indefinitely under any conditions. Sugar, coffee, and tobacco are the principal articles coming north. At the present rate of development of the agricultural resources of Porto Rico and the trade with the States, it may be expected that before long shipments of perishable products both northward and southward will be properly cared for. The horticultural interests may be depended upon to help bring this about, as the prospects of shipping early fruits and vegetables to New York are said to be very promising. Until better facilities are available butter will have to be forwarded in the "coolest part of the ship." No one should be misled, however, into thinking that that is necessarily a cold place.

Outside of a refrigerator, no part of a ship going to the Tropics is very cool. Between decks, where there is free ventilation, the temperature is about the same as the air outside; probably a little cooler when the ship is going from a cold to a warm region, and perhaps there is a slight advantage in the immediate vicinity of the ship's refrigerator. Below it is liable to be warmer, especially in any place near the boilers. In cold weather, however, some compartments may be so thoroughly chilled before sailing as to remain fairly cool throughout the voyage.

To a large extent the bad effects of heat may be avoided by having the butter in insulated packages and thoroughly cold before delivery to the wharf. This can be done so that the heat will not reach the butter for several days after shipment and perhaps for the entire voyage, as is shown later. To give ample time for cooling, the butter should arrive in New York a few days in advance of date of delivery at the wharf. An additional advantage of early arrival is that such goods are not liable to be too late on account of a misconnection en route.

METHOD OF HANDLING PERISHABLE FREIGHT.

Under the rules of the two steamship companies it is necessary to deliver all goods intended for shipment one or two days before sailing. After being placed on the wharf the goods must await their turn to be loaded. This is a very serious matter during warm weather, because the temperature at New York may be considerably higher than the melting point of butter fat. Special care is supposed to be taken in stowing perishable freight, but too much dependence should not be placed upon this. It is not customary to select a favorable location for butter with reference to other kinds of freight. It is as likely to be placed beside kerosene oil or codfish as with less odorous freight.

MARKS ON SHIPPING CASES.

It is not safe to rely upon observance of instructions marked upon shipping cases. Stevedores often working in a dim light and perhaps unable to read can not be depended upon to heed printed directions or cautions on boxes. The writer was promised by an officer on the wharf that the butter going on the same ship with him should be stowed near the ice box and the officer marked the packages with chalk, "Near ice box." One or two days after sailing it was accidently discovered that the butter had not been placed near the ice box, but had been put between decks with the passengers' trunks; and one strong, well-made chest, which contained a few small boxes of butter and ice, had handles on the ends, and was plainly maked on the top, "This side up," was lying on its side with the cover open about 6 inches. It was noticed also that some shipping tags which had been securely tacked on a few cases for forwarding to New York were torn off, showing the necessity of careful marking on the wood with a stencil.

CHANGES OF TEMPERATURE ON SOUTHWARD VOYAGE.

The changes of temperature from day to day on southward voyages in different times of the year are shown by the following table, the data having been furnished by the New York and Porto Rico Steamship Company:

Table 7.—*Temperatures of air and water as recorded between New York and San Juan.*

	From New York, Jan. 6.		From New York, Mar. 16.		From New York, July 6.	
	Air.	Water.	Air.	Water.	Air.	Water.
Sailed at noon:						
First day—	°F.	°F.	°F.	°F.	°F.	°F.
4 p. m.	23	42	38	31	71	72
Midnight	28	48	40	48	73	71
Second day—						
Noon	41	72	52	69	82	81
Midnight	49	68	52	62	79	78
Third day—						
Noon	62	68	64	63	81	80
Midnight	69	71	58	62	80	79
Fourth day—						
Noon	72	74	68	74	81	81
Midnight	70	74	70	71	80	80
Fifth day—						
Noon	76	76	74	74	82	81
Midnight	74	78	73	74	80	80
Sixth day (arrival at San Juan)—						
8 a. m.	......	......	76	78	......	......
Noon	78	78	......	......	79	80
4 p. m.	......	......	......	......	80	81

A maximum thermometer in a box of butter forwarded early in April showed that the butter was exposed en route to a temperature as high as 71° F. During a part of the summer the hottest day of the entire southward voyage is the one a part of which is spent on land before sailing.

DELAY IN UNLOADING BUTTER AT DESTINATION.

The hardship of the voyage is much increased by the fact that there is considerable delay in getting butter off the ship at its destination. The ship on one line arrived at San Juan at half past 10 a. m., and unloading was commenced almost immediately. At 2 p. m. two of the Department packages were found at different places on the wharf, at 3.30 a third case was unloaded, at 5.15 a fourth appeared, and a few minutes later another. This lot arrived at the ice plant at 6.15 p. m., having been exposed to the heat fully six hours longer than was necessary. Before the last two packages of the shipment were unloaded there was an accident in the hold, and all the stevedores were ordered out, to do no more work there that day. As the next day was a holiday, the butter would have stayed in its warm quarters two days more had it not happened that the writer was present and explained to the shore captain the necessity of finding the cases without delay. Another gang was then sent down the hatchway and kept at work until the Department's butter was hoisted out. In order to avoid an occurrence of this kind again, the matter was mentioned in a cablegram to the Chief of the Dairy Division, who immediately called the attention of the New York officers of the company to it, receiving a polite reply from them. Nevertheless, similar trouble was experienced two weeks later upon the arrival of the next ship on the same line. It reached San Juan at 6.30 a. m. No one knew where the butter had been placed in the cargo, and it was necessary to wait until it came off in the regular order. At 2.30 p. m. three cases were unloaded, at 3 p. m. another, and at 4.45 three more. One box of butter was not found until 3 p. m. the next day. Practically the same thing occurred with the other steamship line. The ship arrived at 10 a. m. At 3 p. m. all of the Department's packages were out but two, and they did not appear until the next day. In these cases the delays in getting goods were due chiefly to packages being stowed in different parts of the ship. When one has seen a ship in process of loading he can easily understand how it is that different packages of the same shipment are not kept together. A small army of men is hurrying in and out, each one picking up often what is nearest to hand and leaving it in the ship where most convenient.

A practical remedy might be for the shipper to put some conspicuous identifying mark upon each package, such as a band of paint, and have an understanding with the ship's people that such articles are to be loaded last, kept together, and unloaded first. A regular shipper might after a time get some such special arrangement to working satisfactorily. If better arrangements could be made at both New York and San Juan, the length of time the butter is exposed to unfavorable conditions could easily be reduced one-third.

Customs and steamship officers had not been accustomed to consider butter a perishable product, and it was found to be governed by the same rules as the bulk of goods received, being obliged to remain on the wharf until the entire ship was unloaded, or, at least, until a day or two after arrival. Permission was given, however, to remove the Department shipments as soon as they came off the ship. The cases were then taken as quickly as possible to the ice storage room of the San Juan Ice Company Manufacturing Plant, where they were held until withdrawn for use.

As butter is a very perishable article, the steamship companies should modify certain rules and make others to provide for receiving and loading it as late as possible before sailing, and for discharging and delivering it immediately upon reaching its destination.

Delays are not infrequently caused, also, by failure of shippers to have all necessary papers made out fully and accurately. On this account the delivery of shipments of perishable products is sometimes refused by the steamship companies, and the goods are greatly damaged by being held on the wharf.

DETAILS OF DEPARTMENT SHIPMENTS.

Each week during the writer's stay in Porto Rico a small lot of butter was sent to him by the Dairy Division (Pl. LVI). It was intended that every shipment should include one or two cases from each of four selected creameries located in Vermont, New York, Wisconsin, and Iowa, respectively, and they were thus constituted, except two or three times, when some of the butter arrived in New York too late for shipment. Twice packages of butter were included from firms that had previously shipped more or less to Porto Rico—this for the purpose of comparing their goods and method of packing with those of the Department. With a few unavoidable exceptions, every lot from the four creameries was examined before being forwarded by the official inspector of the New York Mercantile Exchange. The score was always high.

Instructions were not given as to making the butter which the Department sent to Porto Rico. This was left entirely to the managers of the creameries, but special care in packing was directed, so the butter would be protected both from the heat and rough handling en route, and the few shipments showed that too much emphasis can hardly be given to this matter.

Some facts follow regarding the manufacture, the scores in New

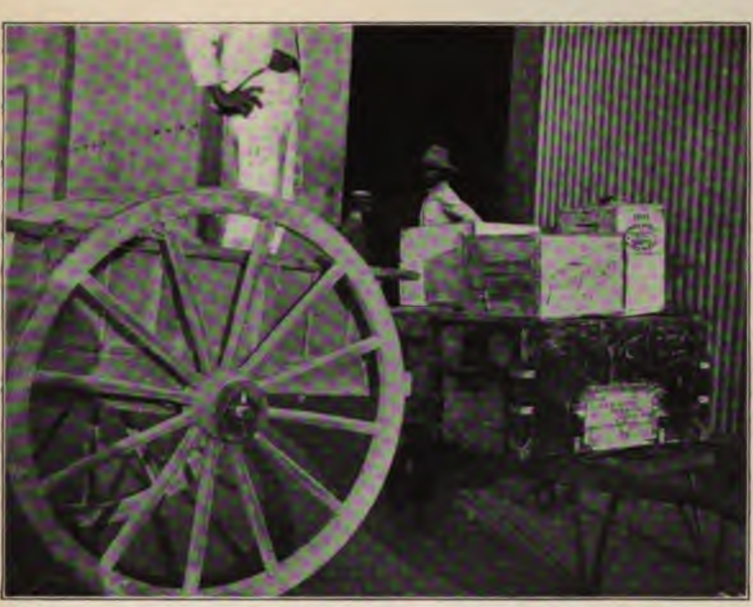

FIG. 1.—EXPERIMENTAL SHIPMENT OF AMERICAN CREAMERY BUTTER.

About to be transferred from wharf to cold storage.

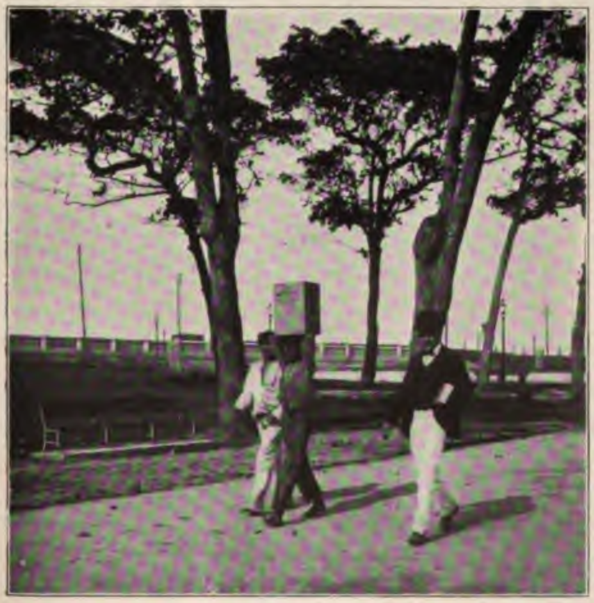

FIG. 2.—DELIVERING 30 POUNDS OF AMERICAN CREAMERY BUTTER TO A GROCERY STORE.

York, chemical analyses, methods of packing, cost of ocean transportation, and condition on arrival at San Juan of the butters from the four different creameries.

VERMONT BUTTER.

Milk was not specially selected. Cream was not pasteurized, and no starter was used. It was ripened and churned at 58° F. The butter was made in a box churn, and it was washed once and worked once. The process of manufacture was exactly the same as for the entire output of the creamery.

Scores of the butter for the different shipments varied from 93 to 96, the average being 94½. The chemical analysis of a single sample was—

Water	9.84
Fat	86.10
Casein, sugar, etc	1.22
Ash	2.84
Total	100.00
Degrees butyro-refractometer calculated to 25° C	50.6

The butter was in 1-pound square prints, about 1¼ inches thick, the top being marked off in 16 small squares. Each print was wrapped in parchment paper and inclosed in a close-fitting heavy wood-pulp paper box, paraffined both inside and outside, the outer coat of paraffin being applied after the cover was put on, so as apparently to seal the package hermetically. Sixty of these small boxes were packed in a heavy shipping case, from the 6 sides of which they were separated by a layer of wheat bran about 2 inches thick, about 40 pounds of bran being used. The temperature was 40° F. when the butter left the creamery. The shipping case was made extra strong from seven-eighths inch pine. The ends were reenforced, and the case tightly bound by twisted wire. It weighed about 150 pounds gross. The outside measurements were: Length, 33½ inches; width, 18 inches; height, 18¼ inches. It occupied about 7½ cubic feet, making its ocean freight practically 78 cents, or nearly 1⅓ cents per pound of butter. On arrival the temperature of bran nearest the outside was from 71° to 74° F.; temperature of butter, 60° to 68° F. The butter and the packages always arrived in first-class order. The special packing increased the cost of the butter in Porto Rico about 4 cents per pound

NEW YORK BUTTER.

Milk was not specially selected. Cream was not pasteurized; it was ripened with the aid of a starter at about 72° F. from four to five hours, then held at 52° F. seventeen to twenty hours, when it was churned at same temperature in a box churn. The butter was washed twice and worked once. In all respects it was made the same as the regular output of the creamery.

Scores in New York varied from 90 to 94, the average being 92½. One sample was analyzed as follows:

Water	11.65
Fat	84.15
Casein, sugar, etc	.94
Ash	3.26
Total	100.00
Degrees butyro-refractometer calculated to 25° C	50.7

The butter was in usual 1-pound rectangular prints, each one wrapped in two pieces of parchment paper. Sixty of these were packed in a neat box made from one-half inch spruce or whitewood, its outside measurements being in length 20½ inches, in width 14½, in height 9½ inches. It, in turn, was placed in a shipping case; the 2 were separated by a layer of dry spruce shavings about 1½ inches thick. The temperature of the butter when it left the creamery was about 40° F. The outer case was a plain box well made from three-fourths inch pine and bound around each end with hoop iron. Its gross weight was about 115 pounds. Its outside dimensions were, in length, 25½ inches; in width, 19 inches; in height, 14½ inches. Its volume was about 4 cubic feet, making its ocean freight 48 cents, or four-fifths cent per pound of butter. On arrival the temperature of shavings was 76° F.; temperature of the butter, 62° to 64° F. The packages and butter always arrived in first-class condition. One time, however, a few of the prints were out of shape; apparently the box had been dropped heavily upon one corner when the butter was a little soft. The special packing increased the cost of the butter from 1½ to 2 cents per pound.

WISCONSIN BUTTER.

Milk was not specially selected. Cream was not pasteurized; it was ripened twenty-four hours at 70° F. with the aid of a starter, and churned at 58° F. in a box churn. The butter was washed twice and worked twice, the intervals between workings being twenty minutes. The butter was made in the same way as the regular product of the creamery.

Scores in New York were from 91½ to 96, the average being 94. The analysis of one sample was:

Water	9.73
Fat	87.64
Casein, sugar, etc	.83
Ash	1.80
Total	100.00
Degrees butyro-refractometer calculated to 25° C	51.3

The butter was in half-pound prints, and these were wrapped in parchment paper and put into individual cartons or paper boxes.

Sixty of these cartons (30 pounds) were packed in brine in a square tin can, which was surrounded on 4 sides by corrugated paper and on top covered with sawdust. All this was contained in a box made of three-fourths inch wood, painted blue. The box was not bound by iron or wire. Its gross weight was about 54 pounds. Its outside measurements were 11¼ inches square, 16¼ inches high. It occupied nearly 1⅕ cubic feet, making the freight charge from New York to Porto Rico practically 15 cents, or one-half cent per pound. On arrival the temperature of the butter varied from 66° to 75° F. In every shipment but one this package arrived in good condition. Once one side split from top to bottom and the outer box was nearly lost off. This might not have happened if more care had been taken when the top was nailed on or if a piece of hoop iron had been used. As a rule, the butter was soft on arrival, though well contained by the small packages. The cost of this butter was increased about 2 cents a pound by its special package.

IOWA BUTTER.

Milk was not specially selected. The cream was pasteurized; it was ripened with the aid of a starter ten hours at 65° F., and churned at 48° F. The butter was made in a combined churn and worker, washed once and worked twice with an interval of one hour. The only difference between this butter and the usual output was that it was supposed to be a little drier.

Official scores in New York were 92 to 97, the average being 95. The chemist's report showed—

Water	12.30
Fat	84.28
Casein, sugar, etc	.99
Ash	2.43
Total	100
Degrees butyro-refractometer calculated to 25° C	51.5

The butter was in usual 1-pound rectangular prints, each wrapped in one piece of parchment paper. Sixty pounds, in heavy cardboard boxes holding from 2 to 8 pounds each, were forwarded in a light box of three-eighths inch wood, such as is commonly used for shipments to New York City. Except in the first shipment, when a double case was used, there was no attempt to protect against heat nor were the boxes bound by iron. The gross weight of a box was nearly 75 pounds. The outside dimensions were, in length, 16¼ inches; in width, 15¾ inches; in height, 11⅜ inches. It occupied about 1⅔ cubic feet and amount of boat freight was only 20 cents, or one-third of a cent per pound. On arrival the temperature of a print of butter near the side of the box was 76° F.; print near the center, 69° F. These boxes could not be depended upon to stand rough handling and they sometimes arrived badly broken. One would have separated into two parts had not some person repaired it en route with pieces of hoop iron. On arrival the butter was very soft and prints had lost their symmetrical form.

SMALL SHIPMENTS IN ICE BOXES.

For purposes of comparison, almost every shipment included a butter chest which carried a small package of butter from each creamery and a water-tight compartment filled with ice. Usually the ice was all melted a day or two before the arrival at San Juan and the butter reached there in no better condition than that which had been specially packed to protect against heat and had no ice. In one shipment the temperature of the water in the ice can on arrival was 71° F., while the four brands of butter varied from 62° to 65° F. During another shipment the steamship officials had this chest carried in the ice box with the ship's provisions. In this case the temperature of the butter was 41° F. on arrival.

OTHER BUTTERS INCLUDED IN EXPERIMENTS.

A few pounds of butter packed in earthenware jars (see p. 342), such as is now extensively used by our army in Porto Rico and Cuba, were included in the shipments. This butter arrived in excellent condition, but in the opinion of some dealers the cost and weight of the package are against it. The tops of the jars are secured by plaster of paris, and when filled with 2 pounds of butter the weight of one of them is nearly 5 pounds. The white jar is a very attractive package and is, of course, entirely free from all suspicion of taint. Each jar is packed in a cubical box of corrugated packing pasteboard as a protection against heat and breakage. It is not believed that the butter is protected from heat in this style of package as well as in some of those described above which are less expensive. The outside measurements of a case containing sixteen jars, or 32 pounds of butter, is 28 by 15 by 14 inches, the cubic space occupied being over 3 feet. Hence the freight from New York to San Juan (12 cents per cubic foot) is a little over 1 cent per pound. The quality of the butter was excellent, and one of the largest houses in San Juan that tried it was anxious to have the exclusive agency of the brand, and as willing to give an order immediately for 30 cases a month, and thought the quantity would rapidly increase.

A little butter was taken also from a shipper who already had some trade in Porto Rico. It was in half-pound and 1-pound cans, some of which were found to leak when the butter became warm. It was not as good in quality as the Department's butter, though much better than what the same shipper was in the habit of sending to his trade as fine goods. It was distributed among some of his own customers, who were surprised to know it could arrive in such good condition, and they said they proposed to have some of that kind in the future if possible.

KEEPING QUALITIES OF THE DEPARTMENT BUTTERS.

When held in the ice room of the ice manufacturing plant, the butter was found to remain in excellent condition from three to four or more weeks after arrival, showing the possibilities of handling such goods with present transportation facilities and cold storage at the other end. The butter also kept remarkably well without cold storage, showing what may be expected from it when properly packed so as to be easily handled, though very soft.

A few pounds of butter from each creamery in the shipment received April 4 was kept out of the refrigerator and exposed to the same conditions as butter is ordinarily subjected to in Porto Rican stores. Notes as to quality of the butter at later dates are as follows:

State of origin.	April 11, 7 days after arrival.	April 18, 14 days after arrival.	April 23, 19 days after arrival.	May 6, 32 days after arrival.
Vermont	Very slightly off flavor.	Slightly off flavor.	Not rancid, but a slight disagreeable flavor.	Off flavor, but not bad.
New York	Slightly off flavor.	Very little rancid.	Very little rancid; salty.	Slightly rancid and "oily;" salty.
Wisconsin (not kept in brine).	Distinctly off flavor.	Very little rancid; seemed salty.	Slightly rancid; about same as best canned Danish.	Slightly rancid and "oily;" salty.
Iowa	Very slightly off flavor.	A disagreeable flavor, which was different from plain rancidity.	Odor and taste both bad.	Rancid and bad.

These results are in accord with the general behavior of the different brands during the entire time they were used.

When the butter was kept in cold storage until a few days before use, it was found to be safe to hold it two or three weeks, which is very fortunate, on account of fluctuations in demand and distance from source of supply. When a merchant has a trade running fairly even from week to week, he might find it entirely satisfactory to receive butter shipments every other week.

COMMENTS ON PACKING AND PACKAGES.

Too fine conclusions as to best method of preparing butter, best form of packages, etc., should not be formed upon the results of these experimental shipments. It would be necessary to make many shipments of butter from the same creamery, but packed in various different ways, to settle these points definitely. The advantage of special packing to protect against heat was plain enough, there being a difference of nearly 15° between the temperature of butters packed in different ways, some being so soft as to be handled only with much difficulty.

It would be a mistake to condemn pasteurization, because the only butter from pasteurized cream was the first to go off flavor. Probably the pasteurization of the Iowa butter had a good effect, which was more than overbalanced by the very unfavorable conditions noted, to which it, but no other butter, was subjected, namely, an extra long land journey and no special protection from high temperature.

The Vermont packages were generally well liked. Though they were not grease proof, several experienced dealers thought them superior to any other package, especially for use when the butter is kept cold practically all the time until consumed. The boxes are shallow, and on this account the butter is liable to show the effects of heat a little sooner than when in blocks nearer the cubical shape. It not infrequently happened that the raised lines made by the mold on the surface were obliterated on account of the butter being allowed to get soft.

The Wisconsin package, which carries the butter in brine, seems to have much to commend it. It is comparatively cheap and of light weight. On account of trouble at the creamery, the shipments of that butter were unfortunately stopped before a special test could be made to determine just how long butter in this package would keep its flavor.

Two pieces of parchment paper wrapped about the same print of butter as, used by the New York creamery, make a fairly good package—much better than would be supposed. It is always well to have butter first wrapped in a piece of blank parchment paper, so that all wrappers with marks upon them can be removed in case the butter deteriorates, leaving a neatly wrapped package to be sold as a second-grade article without discredit to the mark.

GENERAL SATISFACTION WITH BUTTER FORWARDED BY THE DEPARTMENT.

The writer, as well as many others, was surprised by the good condition in which most of the butter arrived in Porto Rico and by the fine flavor of all of it. And the length of time that most of it retained its good qualities was a continuous surprise. Samples were sent to many prominent Americans and Porto Ricans and all spoke in high praise of it. Prof. M. G. Brumbaugh, commissioner of education, wrote:

> I wish to thank you very sincerely for the sample of American dairy butter which you so kindly sent to my home. I do not hesitate to declare that it is by all odds the best butter that I have had in Porto Rico. In fact it is as good as the creamery butter which I obtained in the Philadelphia markets during my residence there, and it will be a source of very great pleasure to me and to my family if some arrangements could be made that we could obtain this butter here in San Juan. The for-

eign butters that reach this market are not to be compared with this in quality or flavor, and I see no reason why the large consumption of foreign butter here should continue at the expense of the American dairymen. In this new field, it seems to me, they ought and easily can preempt the ground and control the market.

Hon. G. W. Whitehead, collector of customs, wrote:

Acknowledging the receipt of a sample package of butter, I desire to testify to the excellence of the article, and to thank you for your courtesy. The introduction of American goods into Porto Rico is steadily increasing in volume, and there is no feature of it more welcome, it seems to me, than a prime article of butter, such as the Department you represent has recently sent here. I believe that the experiment will prove a success, and to that end I shall be glad to render all possible aid.

Mr. Benj. E. Tilton, of the United States Coast and Geodetic Survey, wrote from one of the Survey's camps: "The butter is splendid and sweet; that in the packages holds its flavor well. We have enjoyed it very much." This referred to a small package of butter which was exposed to the heat one whole day in shipment from San Juan and had been held at camp several days before use.

Equally favorable comments came from Porto Ricans, many of whom, however, did not at once appreciate the high quality, as such an article was entirely new to them. They knew only of butter with a more or less rancid flavor. A prosperous and well-informed wholesale merchant who had handled Danish butter many years admitted that our butter which he saw was much better. He was pleased with both the quality and the Vermont package.

INTRODUCTION OF BUTTER THROUGH STORES.

Although many of the leading importers are at present tied up by agreement or prejudice to European brands, or strongly of the opinion that no good butter can come from the United States, there were those that were willing and glad to sample our trial shipments and some commenced immediately to handle our butter. One firm in San Juan, with connections in all the principal cities on the island, announced their seeming departure from a strictly importing and commission business by a large number of postal cards, sent principally to Americans, as follows:

APRIL 3, 1901.

We have just received a sample lot of butter from a representative of the United States Department of Agriculture who is in Porto Rico for the purpose of introducing the best product of American creameries. It will be placed on sale to-morrow morning at 40 cents per pound. It is unquestionably the finest butter that has ever come to Porto Rico. We would be glad to have you try it.

And a little later postal cards went out in English and Spanish, as follows:

If you do not now use butter or you are dissatisfied with what you are getting, we would like to have you try the FINE CREAMERY BUTTER which we are receiving through the UNITED STATES DEPARTMENT OF AGRICULTURE. It is of the same quality as is sold in the best stores in the States and its price is only 40 cents a pound. TRY A SAMPLE GRATIS.

Si Vd. no está usando mantequilla ó no está conforme con la que Vd. está obteniendo, nosotros deseariamos que Vd. probase la MANTEQUILLA DE CREMA que estamos recibiendo por conducto del DEPARTAMENTO DE AGRICULTURA DE LOS ESTADOS UNIDOS DE AMÉRICA. Es de la misma calidad que la que se vende en los mejores colmados del norte, y su precio es solamente 40c. la libra. PRUEBE UNA LIBRA DE MUESTRA GRÁTIS.

A few samples were distributed with this printed note:

We take pleasure in presenting to you herewith a sample of American creamery butter, which we guarantee to be absolutely pure. We would be glad to have you try it on your table and call on us for more. Price, 40 cents per pound.

This statement accompanied every pound sold:

This butter was made in a creamery which is famous for the high grade of its product. It is guaranteed to be of first quality. If you do not find it free from rancid or other unpleasant flavor, we ask you to return it and get your money back. It should be kept in a cool place.

The writer did not hear of any butter being returned. The same firm also advertised the butter in a newspaper and in the street cars. A crude ice box (which was pressed into service until a better one could be secured) required about 25 pounds of ice per day to keep from 60 to 80 pounds of butter in good condition.

One of the best retail stores in Porto Rico (and owned by Spaniards) agreed to handle the butter, and gave an order for a regular weekly supply. They put up several large posters in their store like the following for the benefit of Americans and Spaniards:

FINEST
AMERICAN CREAMERY
BUTTER.

RECEIVED FROM NEW YORK
EVERY WEEK
AND KEPT FRESH IN A REFRIGERATOR.
40 CENTS A POUND.

HAY MANTEQUILLA
AMERICANA
SUPERIOR.

RECIBIDA SEMANALMENTE
DE NEW YORK
Y CONSERVADA FRESCA EN REFRIGERADOR.
40 CENTAVOS LA LIBRA.

And this advertisement was inserted in the daily paper:

AMERICAN BUTTER.

New butter in half and 1 pound packages. This butter is the best manufactured in the United States, and is sent as samples by the Department of Agriculture at Washington. We keep it in a special refrigerator for butter only. Price, 40 cents.

A similar advertisement in Spanish appeared in a Spanish newspaper. At the first this store expected to use only about 100 pounds per week, but in a short time they found this amount too little, and reported that their sales of European canned butters had practically ceased in favor of fresh American prints, which their customers much preferred.

Numerous other merchants who were more or less favorably disposed might be referred to. The principal questions asked were

"What will such butter cost?" and "Can the same quality always be depended upon?" These questions any honest shipper should be able to answer to the entire satisfaction of the inquirer.

MOST SUITABLE PACKAGES FOR TROPICAL TRADE.

The kind of package best suited for sending butter to a warm climate has not been agreed upon. There have been many attempts to get a package that would meet all the requirements, but none has been entirely successful. From what has preceded it is seen that small individual packages must be used. The most common sizes should be one-half pound, 1 pound, and 2 pounds, but some 5's and larger sizes are wanted. They should be inexpensive, otherwise the cost of the butter will be increased in too great proportion, and they should not, for obvious reasons, be too bulky nor too heavy; they should be made of some material that will not impart a flavor to the contents; they should be capable of holding butter in a melted state, which means that they should be well made and securely closed; they should be capable of being easily opened, and last, but by no means least, they should be neat and attractive in appearance.

The Department did not attempt to determine just how all these conditions could be met, but a few different styles of packages were used and they assisted in forming some definite conclusions.

When it is possible to keep butter cold and hard practically all the time until it is consumed, a light pasteboard package (the butter being wrapped first in blank parchment paper) is useful, though not absolutely necessary. Such packages would probably have prevented the prints of New York butter from losing their shape when they became a little soft in one shipment already referred to. Something of the kind is also needed for protecting the butter while it is being carried from the store to the home, as it is the custom of householders to get butter often in small amounts and carry it themselves instead of having it delivered, as is usually done in the States. A heavy pasteboard box, such as was used with the Vermont butter, is better than a light one, although more expensive.

But the consideration of different kinds of packages becomes most important when we refer to shipments that will be exposed to high temperatures for longer or shorter time, as is necessarily the case with nearly all of the butter sold, and will for some time be the case with all but what is taken by the best trade in the two or three largest cities. For butter which is to be exposed any length of time to high temperature no package is as satisfactory as a hermetically sealed tin or glass jar. All of the plain and paraffined pasteboard boxes which were tried leaked the melted fat after a longer or shorter exposure to a high temperature. There was much difference in the packages in this respect, but sooner or later the grease found its way through every one, first in spots and finally through all six sides. The heavy well-paraffined Vermont boxes held the soft butter better than any others of that class, and they might be successfully used when the exposure to a high temperature is not for more than a few days, but they finally become of a dark color, owing to the penetration of the fat. Some paraffined boxes were seen which had been sent to a Ponce merchant by a New York exporter. They had stood in their own shipping case over a month and were thoroughly saturated with grease and the butter had spoiled. The merchant said the boxes were in the same condition within fifteen days after their arrival.

A special tin can, which it was thought might be a useful package, was tried in one of our shipments and proved to be a failure. It was a round half-pound can, having a plain slip cover, which fitted snugly over a ring of cloth saturated with paraffin. This method of closing was tried because it could be used at any creamery without the installation of special canning machinery. It was found to be watertight, and it was supposed it would effectually hold the grease. The principal reason it did not hold the grease was probably because of the expansion of the bulk of the butter when its temperature is raised, causing a considerable pressure from within. The bulk of butter is increased about one-thirtieth when its temperature is raised 40° F., which is not an exceptional range. This means that the cubic space occupied by 1 pound of butter at 95° F. is equivalent to the space occupied by 1 pound and practically half an ounce at 55° F. The expansion is bound to occur when the temperature is raised. If the butter is in any kind of a package that can not withstand pressure outward, a little of the grease will find its way through some weak place. This explains also why so many of the American so-called hermetically sealed tins referred to above were found to be leaking. They had been poorly soldered or closed by a folding process that could not hold melted fat when under a little pressure. Butter in a strong package which allows no leakage expands just the same when the temperature is raised, but usually the package yields a little, and the air, which is very elastic, is compressed into smaller space.

A tin can seems to be the most satisfactory package for general use, but a method of sealing has not as yet been devised. Soldering is objected to for several reasons, one being the effect of the hot iron on the contents of the can, but it is doubtful if the use of the iron produces as bad an effect on the butter as many suppose. The method generally practiced of folding together the edges of the top and sides, and thus closing cans without solder, is not entirely satisfactory because of the many cans which are found to leak.

It is an excellent plan occasionally to test cans when packing by wrapping one in clean dry paper and placing it for a few hours in a warm place to ascertain if it is securely sealed; if it is not securely sealed, grease will soon appear on the paper wrapper.

BUTTER SHOULD BE KEPT COOL WHENEVER POSSIBLE.

Some claim it is not well to refrigerate butter for the Tropics, as such butter when exposed to the heat spoils sooner than it would have done if held all the time at the atmospheric temperature. Experiments to prove this claim are not known. The belief is probably based upon results noticed when butter has been removed too suddenly from a very low temperature to a high one. On the contrary, there is no doubt that butter would be better two weeks after churning, for example, if kept cold the first ten days, than if allowed to be in a nearly melted condition all the time. For this reason it is well to keep butter cold, whether in packages hermetically sealed or otherwise, so far as possible on its way to the consumer.

IMPORTANCE OF UNIFORM QUALITY AND SUPPLY.

It is of the first importance to have goods which are being introduced always uniform in quality. It is difficult to recover from the effect of a shipment of goods of lower quality, especially when the brand is still new. As butter naturally deteriorates with poor care and with age, the reputation of the producer sometimes suffers because his product has been held too long, for which he is not in the least responsible. One way to guard against this would be to put the date of packing on each package, as is the practice with various kinds of perishable goods, such as candies and photographic supplies. Without this, butter could be delayed an indefinite time en route or held to await the sale of fresher goods which had been piled upon it, and then sold, the purchaser thinking it a sample of what might be expected at any time. Dating packages would doubtless result in merchants using more care to keep fresh supplies.

Regularity of shipments is almost as important as uniformity of quality. It is extremely aggravating to the customer and prejudicial to the goods being introduced to have the supply exhausted on account of carelessness in this respect.

Some persons think that butter should keep indefinitely when in hermetically sealed tins, the same as do meats and vegetables. They overlook the important fact that all bacteria in these articles which cause them to spoil are destroyed by heat, while butter contains an immense number of bacteria, and a large part of them can grow as well in a sealed tin as in a butter tub, and perhaps some grow better. The sealed package is of value, as it prevents the entrance of additional forms of bacteria and holds the butter under all conditions.

A study of methods of preserving butter is one of the most interesting of the dairy subjects awaiting scientific investigation. A method of destroying bacterial life in butter, and under which the good qualities of the butter would be retained, as is practicable with most other food products, would be a boon to butter users in districts where ice can not be had. Many germs are destroyed when milk or cream is pasteurized before churning, and this treatment is doubtless beneficial, but experience shows it is not a panacea.

Some simple experiments have been conducted in Washington by the writer, and at the Pennsylvania Experiment Station by Prof. Harry Hayward and the writer, to determine the effect of heating butter upon its keeping quality and flavor. It has been found that the keeping quality is very decidedly improved when the butter has been heated to about 190° F. for half an hour, but the flavor is somewhat affected. The peculiar cooked and melted-butter flavor, however, is not to be compared with the spoiled flavor of most of the butter handled in the usual way and a few months old. The butter was vigorously shaken while cooling, to keep its constituents intimately mixed. There is opportunity for further experimental work along this line. It is probable that the changed flavor can be much reduced if not entirely overcome. It is not noticed in well-made renovated butter.

INTRODUCTION OF NEW BRANDS.

The introduction of new brands of dairy products is not necessarily a profitable undertaking from the very first. American firms dealing in other lines fully appreciate that it requires time and money to introduce new brands. Large concerns send their own agents to the island, advertise extensively, and bear most of the expenses of introduction, spending money freely in this way for a considerable period. It is not recommended that exactly these methods be employed by those seeking to introduce new brands of butter, but they should be content for a reasonable time with the smallest possible net price, having an understanding with the ones who handle the butter that every effort shall be made to improve its standing. It would be well to send the first few shipments on consignment with instructions that they be disposed of promptly while fresh for what they will bring. When a trade has been established it is advisable to make definite quotations for several months without change to avoid the uncertainty of fluctuations.

As a general rule it is best to introduce goods through well-established houses, many of which in Porto Rico have representatives in New York City. There are also in New York City numerous export commission houses which do a general business with any from whom orders are received, charging a commission of about 2½ per cent. Some Porto Rican merchants, however, prefer to deal directly with those who furnish supplies. It is a common practice to make one house the exclusive agent for its own district or the entire island.

COMMISSION CHARGES AND COSTS.

One of the leading commission houses in San Juan, with an office in New York, collects from 5 to 7½ per cent when selling small lots of goods on consignment, and 5 per cent for handling regular orders and making remittance by return steamer, and 10 per cent if held responsible for payment within thirty days. Retailers expect a profit of about 25 per cent. Considering butter to be worth 22 cents in New York, the items in connection with a shipment of 100 pounds to San Juan would be about as follows:

100 pounds butter, at 22 cents, New York		$22.00
Extra for special packing, at 2 cents		2.00
Freight, New York to San Juan, at 1¼ cents		[a]1.25
Insurance		.25
Porto Rico internal revenue		[b].50
United States internal revenue		[b].03
Cartage in San Juan		[b]1.00
Cost delivered in San Juan		27.03
Commission or wholesaler's profit, 10 per cent		2.70
Ice in wholesale store		1.00
Wholesale price in San Juan		30.73
Or per pound	cents	30.8
Profit to retailer, 25 per cent	cents	7.7
Can be sold to consumer in San Juan at	cents	38.5

About 2¼ cents should be added for special packing for places where ice is not available. One to 2 cents should be added for transportation to other points than San Juan or Ponce.

Probably for at least six months in every year the cost per pound could be reduced 3 to 5 cents, as the original cost in New York would be considerably below 22 cents; and further reductions could be expected with the development of trade.

THE OUTLOOK FOR STATES BUTTER IN PORTO RICO.

There is no question about what country should furnish the butter used in Porto Rico until the markets can be supplied by home production. Although the total amount of butter used is small, being not more in a year than is often received in New York City in a single day, it is a trade which should be sought, developed, and entirely supplied from the United States. Some of the advantages which our shippers possess over those in other countries are as follows: No tariff charge—others must pay 6 cents per pound; nearness to the market—no dairy country is so near as the United States, and most of them, in point of time, are three times as far; regular and frequent steamship service; ability to produce butter as cheaply as our competitors, if not more so; the development of a loyal and friendly feeling on the part of Porto Ricans toward this country and its products; and the assistance of a large and continually increasing number of Americans on the island who prefer American supplies. It is estimated there are 2,000 or more Americans in Porto Rico, one-half of whom are in San Juan. Most of them would be glad to get the same kind of butter as they were accustomed to in the States, though a large portion of them are boarding and can not dictate what kind of butter shall be served with their meals. These advantages are not merely nominal, and if properly followed up they will soon result in the practical exclusion of all butters except our own. The favorable tariff alone should give the entire market to us in a very short time.

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[a] An even 100 pounds is considered because this is a convenient amount, but unless shipments were larger, freight rate would have to be increased, because of the minimum freight charge.

[b] These items would be the same for larger shipments.

Against the advantages there are some practical difficulties. A few of them are named elsewhere. One of the chief difficulties is the conservatism of most Porto Ricans. They are slow to adopt new articles. It will require some time to make known the superiority of good American butter. It must also be remembered that the finest butter can be afforded only by a certain class of people, quite limited in number.

SUMMARY.

A summary of the principal points in connection with the experimental shipments of butter to Porto Rico is as follows:

During most of the year if not all our best butter can be safely forwarded with present facilities of transportation, though these should be much improved.

The same quality of butter can be sent to Porto Rico as to Southern cities in the States. Whether or not it will long remain in good condition will depend principally upon the care it receives after arrival.

Porto Rico offers only a limited market for butter, of which but a small portion may be of best grades. A very few creameries could easily supply the market for good butter.

But the demand for both the better and the cheaper grades will certainly increase when they become well known and are offered at reasonable prices. Leading merchants agreed that good States butter at any price less than 35 to 40 cents per pound wholesale would soon replace the higher-priced foreign brands.

It will require both time and money successfully to introduce a new brand. Brands already well established on the market will not be displaced at once, and others can be successfully substituted for them only when superior in quality and offered at more favorable prices.

Porto Ricans are faithful to any brand which they have found by long experience to be reliable. The compensation for the difficulty in introducing goods is the strong position they occupy after introduction.

There are quite a number of houses in New York having more or less business in Porto Rico, and probably the best way to sell goods on the island is through these houses. Special care should be taken to select a responsible concern that will endeavor to have the butter handled as it requires.

Butter should be the very best quality that can be furnished for the price asked, and quality should be kept uniform.

Definite prices should be quoted for as long periods as possible.

Preservatives should not be used.

Color should be the same as in home markets. Porto Ricans are accustomed to light salt in the best grades.

Generally butter should be in tin, but there is a place for a little in prints.

All prints of butter should first be wrapped in a good quality of blank parchment paper, then inclosed in another parchment paper with brand upon it, or in a pasteboard box with printed sides. Selling agents should be instructed to remove all marks, and sell for what it will bring any butter that has spoiled or is not a credit to its mark. The blank parchment may be left on the butter and will enable it to be handled. Marks imprinted in the butter are of little use; on account of the high temperature they are soon obliterated.

Care should be taken to fill packages completely full of butter, so as to exclude all air possible.

Whether butter is in special package for exposure to high temperature or not, it should always be kept as cold as possible.

Most of the butter for retail trade should be in one-half, 1, and 2 pound packages; a small part of it in 5 and 10 pound packages. Some merchants claim that a 400-gram package will sell for as much as a half-pound (about 450 grams) package. There may be a temporary advantage in the less weight, but it is not believed it will long continue.

Packages should be made of good material that will not rust or impart any flavor or odor to the butter; and if they are to be exposed to high temperatures, special care should be taken to have all joints secure, so that when the butter expands and causes pressure from within there will be no leak.

The package should be neat and attractive in appearance, but the quality of the contents should be the first consideration.

The imitation of labels of brands already successfully introduced or the sending out of samples which are better than the line of goods to follow is an underhanded practice, and will not pay in the long run.

Paper labels on tin cans are objectionable, because they so easily become soiled and torn. If they are used, special care should be taken to have them attached at all points. They might be covered with some transparent waterproof substance to protect them from dampness. Such cans should be in outside wrappers for additional protection to the labels. An advantage of paper labels is that they may be removed and the butter sold for what it will bring if it spoils, and no harm is done to the mark. The reputation of certain first-class brands has been ruined in some towns because the butter was spoiled when it was sold. It would often be better to lose a shipment entirely than to work it off with labels intact after it had spoiled.

Packages should be dated to prevent their being sold as fresh goods when they are old and contents deteriorated. It might be well to imprint date (month and year) in the bottom of all tin cans.

It is well to have some special arrangement by which a tin can may be easily opened and to provide a cover for use after the can is opened and until emptied.

When shipments are made to an agent who distributes to numerous others, it will be well to pack 10 or 20 of the unit packages into small light boxes, and several of these in turn into larger shipping cases. Then when goods are received at San Juan there need be no delay in forwarding small orders, as these will be already packed. If an assortment of sizes of small packages is forwarded, each box should contain some of every size, so it will be necessary for the small dealer to purchase only one box, or have but one on hand at a time. For example, small boxes could easily be made to hold 10 half pounds and 5 one pounds for a 10-pound order, or 12 half pounds, 6 one pounds, and 2 two pounds for a 16-pound order, and large boxes might contain more in the same proportion, or any other desired.

All butter which is not to be protected by cold for practically the entire time until used should be packed in such a way as to be protected as much as possible from heat. An insulating material more than an inch in thickness between the butter and side of packing case is desirable.

As butter is itself a poor conductor of heat, shipping cases should be as large as practicable.

Shipping cases should be strongly made and bound with iron, and plainly marked with a stencil or brush, not cards or tags. The necessity of strong shipping cases is greatest when shipments are small, as they are then most liable to come into contact with other heavy freight.

Each case should be marked "*Perishable; keep in cool place.*" Instructions to handle with care or to keep a certain side up will not often be heeded.

Shipments should be large enough to avoid an excessive freight rate on account of the minimum charge.

Care should be taken not to overload the market, as this will result in goods being held to their damage.

One of the first essentials for a successful trade, and especially a new trade, is to make shipments regularly and not to disappoint customers by the failure of an expected lot to arrive.

Butter should be thoroughly cold when shipped, and great care taken to have shipments forwarded regularly without interruption. For these purposes it is well to have goods arrive in New York three or four days before forwarding and held that length of time in cold storage.

Shipments should be put in a cold place as soon as possible after arrival at destination.

IMPORTED CHEESE IN PORTO RICO.

STATISTICS.

In addition to the cheese made in Porto Rico, and which is referred to at some length elsewhere, a considerable quantity is imported from the United States and certain European countries. A complete record of imports in all recent years is not available, but as full a statement as possible has been compiled from various official documents (table 8). This statement shows that in the calendar year 1892 the total imports of cheese amounted to 1,456,326 pounds, and in each of the following three years they were slightly less. Then there was a decided falling off, so that in 1896 the imports amounted to only 722,844 pounds, or an average of about 2,000 pounds per day. They were practically the same for 1897, about 35 per cent greater in 1899, and fell back to 710,956 pounds in 1900. The receipts from Netherlands—formerly the chief country of supply—have shown heavy decreases, while those from the United States—formerly second in importance as a country of supply—have shown large fluctuations, and in the last few years have gone ahead of all others. In each of the years 1893 and 1894 Netherlands furnished almost 1,000,000 pounds, or 75 per cent of the total. In 1897 the imports from that country had decreased more than 50 per cent, or to 458,200 pounds, which was 61 per cent of the total, and in the following years they continued to fall rapidly. The imports from the United States decreased from 201,459 pounds in 1893 to 20,075 pounds in 1897—a loss of over 90 per cent; but from 1897 they rapidly increased. Imports from Germany showed an increase up to 1897, when they amounted to 92,470 pounds, then a decrease to 9,045 pounds in 1900. There was an increase in receipts from the United Kingdom from 1894 to 1899, in the latter year being 120,874 pounds. Cheese was received from a few other countries, among the most important of which were Spain, France, Belgium, and Italy.

Since September, 1898, a statement of the quantities of cheese imported is available for each month, and the records show large fluctuations in the receipts from different countries (table 9). From May, 1900, when tariff rates took effect which were especially favorable to goods sent from the United States, the receipts of cheese credited to this country have increased, while the receipts from all other countries have diminished. (United States tariff laws regarding butter and cheese are the same. For discussion, see p. 327.) Changes took place so quickly that within a few months the bulk of the trade had been turned to the United States. In May, 1901, there were received from the United States 91,773 pounds of cheese and from all other countries combined only 20,104 pounds.

In a general way the statistics indicate the quantities of the different kinds of cheese imported, as a typical variety is generally received from each different country; but exact information is not thus furnished, for the reason that cheese is often reshipped, hence is not the product of the country to which it is credited in the reports of imports.

TABLE 8.—*Cheese imported into Porto Rico in the calendar years 1892 to 1901.*

Country of export.	1892.	1893.	1894.	1895.	1896.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
United States	....	201,459	63,645	....	22,020
Other countries:					
Netherlands	....	945,185	996,508	....	517,126
United Kingdom	....	67,642	36,574	....	93,718
Germany	....	39,927	66,587	....	42,921
Spain	....	15,311	65,565	....	35,291
France	....	11,541	13,439	....	9,484
Italy	....	1,078	79,981	....	2,284
French Possessions	....	1,433	....	....	....
Danish Possessions	....	1,060	....	....	....
Total	1,456,326	1,284,636	1,322,339	1,286,166	722,844

Country of export.	1897.	1898 (Sept.-Dec.)[a]	1899.	1900.	1901 (Jan.-May.)[a]
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
United States	20,075	44,904	297,577	401,825	291,772
Other countries	....	....	....	....	47,736
Netherlands	458,200	49,072	387,942	261,861	....
United Kingdom	93,931	18,508	120,874	15,524	....
Germany	92,470	11,441	66,607	9,045	....
Spain	52,767	330	18,913	9,453	....
France	14,052	498	10,763	4,831	....
Denmark	....	1,150	99,447	4,906	....
Belgium	12,068	....	1,095	1,115	....
Italy	1,497	963	4,084	2,397	....
Switzerland	55	....	....	....	....
Canada	....	1,000	434	....	....
Danish Possessions	....	54	140	....	....
Total	745,115	[a]127,920	1,007,876	710,956	[a]339,508

[a] Portion of a year as shown.

The commerce reports of the United States indicate that large quantities of cheese have been sent from the United States to Porto Rico during the last few decades (table 10). In some early years, for example 1862 and 1863, more cheese is reported to have been exported to Porto Rico than in any recent year. Previous to 1894 the annual exports had often exceeded 200,000 pounds. In 1894 (fiscal year) they amounted to only 130,545 pounds. In each of the three years following a little over 25,000 pounds were exported, and in 1898 only 12,167 pounds. Then shipments increased rapidly to 650,289 pounds in 1901. A considerable part of the cheese sent to Porto Rico from the United States is originally from Europe.

TABLE 10.—*Exports of cheese from the United States to Porto Rico, 1855 to 1901.*

Year ended June 30—	Quantity.	Value.	Year ended June 30—	Quantity.	Value.
	Pounds.	*Dollars.*		*Pounds.*	*Dollars.*
1855	195,878	21,772	1879	216,330	23,678
1856	198,198	21,155	1880	333,591	41,187
1857	265,500	30,928	1881	247,085	30,811
1858	272,473	28,783	1882	211,997	28,855
1859	349,955	36,160	1883	206,090	30,967
1860	256,616	28,443	1884	235,799	31,865
1861	308,489	32,360	1885	200,364	23,885
1862	406,947	35,228	1886	165,867	15,710
1863	478,067	54,867	1887	105,868	14,335
1864[a]	....	....	1888	133,498	16,957
1865	385,183	79,454	1889	118,363	14,231
1866	176,016	35,101	1890	186,624	22,448
1867	158,677	27,741	1891	275,967	32,691
1868	265,265	40,670	1892	247,532	31,368
1869	162,619	28,949	1893	244,884	28,721
1870	148,152	24,295	1894	130,545	16,568
1871	171,902	24,000	1895	25,319	3,038
1872	218,871	27,584	1896	25,404	2,946
1873	193,014	27,911	1897	26,478	3,022
1874	210,813	29,642	1898	12,167	1,535
1875	202,859	30,191	1899	220,917	27,404
1876	163,049	21,516	1900	357,425	42,441
1877	119,505	17,149	1901	650,289	74,621
1878	87,851	12,558			

[a] Exports to Porto Rico not reported separately, but with those to "Spanish West Indies."

EUROPEAN VARIETIES AND PACKAGES.

The best and highest priced cheeses are the European varieties, and the ones most commonly seen are the Gouda (often called "Pâte Grasse"), Edam, and Gruyère. The choicest of these arrive in hermetically sealed packages, the first two named in individual tins (Pl. LIV, fig. 2), and the last in a close-fitting cover of a thin flexible metal, such as zinc or lead. The Goudas weigh less than 10 pounds. They are about 9 inches in diameter and 3 inches thick. The upper and lower

Table 9.—*Cheese Imported into*

Year and month.	United States.		Denmark.		Germany.		Fr
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.
1898.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*
September[a]	1,851	621	....	....	2,795	372	....
October	15,440	1,911	1,150	131	4,854	1,094	....
November	13,849	1,761	....	....	3,521	759	239
December	13,764	1,823	....	....	271	53	259
1899.							
January	11,027	1,531	....	....	1,848	510	2,169
February	23,612	2,327	42,425	4,285	1,708	199	572
March	44,371	5,040	1,111	124	9,556	1,481	....
April	22,191	3,113	53,064	3,913	8,710	1,524	1,775
May	27,727	3,651	2,847	319	8,436	1,456	74
June	41,316	5,000	....	....	19,567	3,074	1,725
Total, 10 months	215,148	26,778	100,597	8,772	61,266	10,522	6,813
July	22,351	2,247	....	....	10,291	1,237	521
August	17,746	1,785	....	....	3,216	533	960
September	14,504	1,729	....	....	1,013	163	415
October	13,712	1,793	....	....	869	89	730
November	29,031	3,870	....	....	1,393	178	423
December	29,989	4,210	....	....	....	....	1,399
1900.							
January	20,794	2,801	....	....	3,102	368	1,530
February	21,568	2,941	....	....	....	....	360
March	26,715	3,688	4,343	584	....	....	65
April	11,085	1,596	....	....	1,189	160	429
May	39,876	5,145	23	6	....	....	....
June	65,703	7,738	....	....	593	117	159
Total, 12 months	313,074	39,543	4,366	590	21,666	2,845	6,991
July	51,178	5,791	539	76	1,011	172	....
August	22,801	2,616	....	....	198	46	450
September	10,897	1,308	....	....	....	....	32
October	17,891	2,041	....	....	919	182	....
November	44,129	3,790	....	....	926	195	710
December	69,188	7,881	....	....	1,107	202	1,096
1901.							
January	53,644	6,557	....	....	....	....	....
February	42,627	5,347	....	....	....	....	....
March	34,851	7,287	....	....	1,216	136	....
April	48,877	7,398	....	....	....	....	....
May	91,773	11,917	....	....	....	....	....
Total, 11 months	507,856	61,933	[d]539	[d]76	[d]5,377	[d]933	[d]2,288
June	....	....	....	....	1,230	261	....
July	....	....	....	....	....	....	95
August	....	....	....	....	....	....	....
September	....	....	....	....	....	....	1,403
October	....	....	....	....	676	202	93
November	....	....	....	....	2,262	425	575
Total, 6 months	....	....	....	....	4,168	888	2,166

[a] Mayaguez, Ponce, Arroyo, Aguadilla, and Humacao only ports occupied in Septemb

[b] Includes 7,249 pounds, valued at $1,036, for April, from countries other than United

by months, September, 1898, to May, 1901.

	Italy.		Netherlands.		Spain.		United Kingdom.		Other countries.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Lbs.	*Dolls.*	*Lbs.*	*Dolls.*	*Lbs.*	*Dolls.*	*Lbs.*	*Dolls.*	*Lbs.*	*Dolls.*	*Lbs.*	*Dolls.*
1	......	......	976	828	......	......	1,387	383	......	......	7,009	1,704
2	......	......	1,500	169	300	83	5,419	1,561	......	......	28,663	4,949
3	......	......	14,833	2,275	30	8	3,200	940	1,000	114	36,672	5,927
4	963	155	31,763	5,593	......	......	8,502	1,857	54	17	55,576	9,540
5	......	......	26,838	2,450	......	......	4,735	873	......	......	46,617	5,661
6	......	......	......	......	1,528	157	3,820	485	......	......	73,665	7,522
7	......	......	46,818	4,242	2,352	263	12,648	2,187	......	......	116,856	13,337
8	......	......	10,990	1,089	9,585	1,013	4,855	635	140	30	111,810	11,483
9	......	......	81,571	2,770	1,302	336	39,272	4,159	......	......	111,229	12,707
10	150	32	16,410	1,570	292	73	33,205	4,971	......	......	112,665	14,883
11	1,113	187	181,699	20,486	15,389	1,933	117,043	18,056	1,194	161	700,262	87,663
12	2,609	425	84,045	3,766	1,410	167	4,493	570	434	40	76,154	8,496
13	767	111	68,959	7,901	......	......	4,028	565	......	......	95,676	10,992
14	52	9	15,446	1,748	1,141	139	5,026	632	......	......	37,597	4,495
15	......	......	9,481	644	699	146	......	......	......	......	25,494	2,717
16	......	......	46,390	4,842	......	......	6,601	691	......	......	83,838	9,714
17	506	26	80,991	9,944	604	79	2,191	247	1,095	122	116,775	14,807
18	123	6	51,549	6,523	1,538	320	2,240	240	......	......	80,876	10,429
19	......	......	43,752	5,294	1,891	274	5,309	582	......	......	72,880	9,149
20	106	11	58,735	6,981	2,463	231	3,239	367	1,115	151	96,781	12,025
21	......	......	27,689	3,249	1,253	134	......	......	......	......	41,645	5,198
22	45	5	3,536	587	......	......	4,736	590	......	......	48,216	6,333
23	959	182	17,451	1,973	518	65	......	......	......	......	85,383	10,092
24	5,167	775	458,027	53,452	11,517	1,565	37,863	4,484	2,644	318	861,815	104,447
25	......	......	23,867	4,778	......	......	......	......	......	......	76,595	10,817
26	......	......	20,963	3,827	176	26	......	......	......	......	44,588	6,605
27	......	......	7,940	1,255	54	13	......	......	......	......	18,923	2,579
28	......	......	1,402	269	6	1	......	......	......	......	20,218	2,493
29	882	154	2,086	300	230	24	......	......	......	......	48,963	4,593
30	282	52	2,891	418	1,324	174	......	......	......	......	75,888	8,937
31	......	......	8,509	1,297	......	......	......	......	......	......	62,153	7,854
32	......	......	2,513	359	880	115	......	......	......	......	46,020	5,821
33	28	2	3,703	596	3,534	403	......	......	......	......	63,332	8,424
34	......	......	......	......	......	......	......	......	......	......	[b] 56,126	[b] 8,434
35	......	......	......	......	......	......	......	......	......	......	[c] 111,877	[c] 15,371
36	[d] 1,192	[d] 208	[d] 73,874	[d] 13,099	[d] 6,204	[d] 756	......	......	......	......	624,683	81,928
37	134	27	18,239	3,076	745	117	......	......	......	......	20,214	3,454
38	......	......	2,429	469	26	5	......	......	......	......	2,684	530
39	......	......	2,933	360	106	18	......	......	......	......	3,039	378
40	79	9	6,772	1,067	300	58	215	69	......	......	8,769	1,385
41	820	153	8,147	1,320	273	47	......	......	......	......	10,009	1,750
42	77	16	3,323	428	121	26	36	12	44	6	6,438	1,002
43	1,110	205	41,843	6,720	1,571	271	251	81	44	6	51,153	8,499

[c] Includes 20,104 pounds, valued at $3,451, for May, from countries other than United States.

[d] Except April and May, 1901, necessarily stated as shown.

surfaces are slightly curved and gradually rounded off into the sides. Many of these are received in shallow square boxes holding four, each resting on the bottom of the box. Holes are bored in the box sides for ventilation, and these are covered with fine wire netting to exclude vermin. The quality of this European cheese is surprisingly good, its flavor is clean and mild, and its appearance is inviting, Sometimes a little butter fat escapes, especially from the Gruyère, but generally the cheese appears quite as dry as could be expected. An importer who receives about 25 cases of Holland, or Gouda, cheese each month reports that it costs 27 cents per pound delivered in San Juan. He sells it at wholesale for 36 cents and at retail for 45 to 50 cents. Swiss cheese is retailed at the same rate.[a] Much Gouda, however, is sold as low as 18 cents wholesale and at 20 to 25 cents per pound retail. Edam cheese, weighing about 4 pounds each, vary in retail price from 75 cents to $1.50 per cheese; they may be bought as low as 60 cents at wholesale. Good cheese is held in high favor as a food, and by many families it is used at both the noon and the evening meals.

AMERICAN CHEESE.

The American cheese imported from the United States falls in a second and very different class. It is generally the "Young America" and "Flat" varieties, that are not so good in quality or appearance as the European cheese, and command a much lower price. It is used largely by the middle and poorer classes. As a rule, it is colored, there being little demand for the uncolored article. The Young Americas

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[a] Various items of expense in connection with an importation of Swiss cheese are shown by the following copy of an invoice:

PORTO RICO, *May 9, 1901.*

Invoice of two packages of Gruyère cheese imported from Bordeaux by the French steamer Ville de Marseille.

2 packages, 169 kilograms net, at 1.85	francs..	312.65	
Discount 2 per cent	do....	6.20	
			306.45
Expenses in Europe:			
Packing and cost of zinc	do....	26.60	
Freight to San Juan and other charges	do....	38.70	
Insurance and policy	do....	5.19	
			70.49
Total	francs..		376.94
Commission, 5 per cent	do....		18.84
Total			395.78
395.78 francs, at 98 cents per 5 francs			$77.21
Expenses in San Juan:			
Customs declaration sheets		$0.10	
Launching and towing		.44	
Cartage		.35	
Duty on 373 pounds, at 6 cents per pound		22.38	
			23.27
Total			100.48

(Average cost, 27 cents per pound.)

are sent in the ordinary cheese boxes, three or four being packed together. Their wholesale price is but little above the price in New York, and generally falls between 12 and 17 cents. They commonly retail at 20 to 25 cents per pound. The principal trouble with American cheese is that it will not keep well. In a comparatively short time it is liable to swell out of shape, considerable butter fat is lost, and the flavor becomes sharp. Some shippers send printed matter with the cheese, directing that it be punctured when swollen on account of formation of gas.

A few selected Wisconsin cheeses made in block form and weighing 10 pounds each were sent to Porto Rico by this Department and their behavior in that climate was carefully noted by the writer. They were encased in paraffin and packed in strong boxes and appeared to be in excellent condition on arrival. The cheese had good body and pleasant, mild flavor. The blocks were rectangular in form and had been marked by the molds to show where to cut to remove pieces weighing 1 pound. In less than 10 days they had swollen enough to crack the paraffin coating, thus making it useless, and considerable fat was lost. This cheese sold readily while fresh at 20 to 25 cents per pound, and a small quantity was disposed of in a leading store for 40 cents per pound. On account of the faults named, however, it is very plain that American cheese as generally made is not so well adapted as some European varieties for tropical trade, and that the opening for a cheese similar to the European varieties which give such good satisfaction is very inviting.

The analyses of one sample of each of the principal varieties of cheese found on the market are as follows:

TABLE 11.—*Analyses of cheese sold in Porto Rico.*

Original No.	Laboratory No.	Cheese.	Water.	Fat.	Casein (N x 6.37)	Ash.	Butyro-refractometer, reading at 25° C.
							°
101	22813	Swiss	29.09	34.57	29.36	4.44	51.6
102	22814	Gouda	34.44	28.25	29.74	5.77	51.3
103	22815	Edam	34.59	29.21	28.98	5.15	49.4
104	[a]22816	Native	35.32	27,17	31.08	5.90	51.0
105	22817	Young America	37.95	31.68	27.08	3.02	49.8

[a] 22,816 is a partially skimmed cheese.

The chemist adds:

The examination shows that all of the samples contain genuine milk fat only. Some of the nitrogenous products of the ripening process contain less nitrogen than does casein, therefore the factor 6.37 used in the above table for the calculation of the percentage of casein from the percentage of nitrogen gives a result which is too small, and so the results of cheese analyses which involve the use of this factor can not foot up to 100 per cent.

CONDENSED MILK IN PORTO RICO.

Statistics of imports of condensed milk into Porto Rico are given in Table 12, for each month from May, 1900, to May, 1901, as furnished by the collector of customs at San Juan. These show that practically all of this class of goods is received from the United States, the amounts averaging about one ton per month, and valued at about $200. During this period, apparently the only other shipments received were one each from France and Germany.

TABLE 12.—*Condensed milk imported into Porto Rico, May, 1900, to May, 1901.*

Year and month.	United States.		France.		Germany.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1900.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
May	2,995	261				
June	3,862	471	231	35		
July	2,336	226				
August	1,132	154			31	4
September	707	77				
October	560	58				
November	2,465	250				
December	2,165	303				
1901.						
January	3,075	350				
February	1,450	196				
March	2,497	326				
April	1,375	144				
May	3,495	365				
Total 12 months, June to May.	25,119	2,919	231	35	31	4

The statistics of exports of the United States show that very small quantities of condensed milk have been sent to Porto Rico in the last thirty or forty years. There has been a marked increase recently. The value of the shipments of the last fiscal year was $2,876 (table 13).

American manufacturers of condensed milk have given careful attention to the requirements and possibilities of trade in Porto Rico. Their product bears an excellent reputation. The packages are similar to those generally seen in the States. One of the best brands retails at 20 to 25 cents per can.

TABLE 13.—*Milk exported from the United States to Porto Rico, 1865 to 1901.*

Year ended June 30	Value.	Year ended June 30—	Value.
1865	$573	1884	25
1866	([a])	1885	75
1867	([a])	1886	164
1868	([a])	1887	44
1869	([a])	1888	53
1870	....	1889	286
1871	....	1890	163
1872	82	1891	145
1873	203	1892	239
1874	....	1893	544
1875	85	1894	605
1876	31	1895	667
1877	5	1896	737
1878	10	1897	729
1879	8	1898	572
1880	213	1899	1,304
1881	....	1900	1,780
1882	9	1901	2,876
1883	97		

[a] In the years 1866 to 1869, inclusive, milk is not stated in the export returns of the United States.

DAIRY CONDITIONS IN ST. THOMAS.[a]

There are few cattle on the island of St. Thomas (Pl. LVII). They are taken there occasionally from Porto Rico, Tortola, and other neighboring islands for slaughter and a small number for milk. Their values run about the same as in Porto Rico. The character of the grazing and the care of the stock are quite similar to what is found in Porto Rico (Pl. LVIII, fig. 1, and Pl. LIX). Water is obtained from wells fed by springs and from cisterns.

At a dairy near the town 50 milking cows are kept. In the dry season these produce about 30 gallons at the single daily milking, and in the wet season the product is increased to 50 gallons. Special precautions to keep the milk pure are neglected. The milk is boiled as often as necessary to prevent souring and much of it is served in liquor bottles (Pl. LVIII, fig. 2). The price is stated to vary from 3 to 5 cents per quart according to the supply and demand, but on account of the small quarts used the prices must be increased about 20 per cent to make them apply to American quarts. Ice is received from Maine and retails at 2 cents per pound.

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[a] The Danish West Indies include three small islands lying only a few hours east of Porto Rico. From a commercial standpoint the island of St. Thomas is the principal one of the group. It is about 13 miles long east and west, and averages about 3 miles in width; it is mostly covered by hills. Its climate and that of Porto Rico are quite similar, and its soil resembles the soil in some parts of Porto Rico. The population is about 15,000. Most of the people live in the one town, which is situated on the bay and named Charlotte Amelia, but generally referred to by the name of the island. Agriculture is a neglected industry. The English language is commonly spoken. The other two islands are not so well known as St. Thomas, as they are visited by comparatively few ships. St. Croix, distant southward about 40 miles, is somewhat larger and more agricultural. St. John has very few inhabitants.

The writer was enabled to visit St. Thomas by the courtesy of an officer of the United States Coast and Geodetic Survey on a schooner in the service of the survey.

The best or table butter is imported from Denmark (see Nos. 8 and 9, table 6). A 400-gram can costs the importer 39 cents and sells at retail for 45 cents. The same article when packed in 7-pound or 28-pound tins is sold for 35 cents per pound. As in Porto Rico, fresh supplies are received at long intervals. A leading merchant told the writer he had imported from Denmark $500 worth of butter in February and he expected it to last six months (without ice). Inferior butter packed in 30-pound to 32-pound kegs is received from Halifax, Canada. Its wholesale price is 25 to 27 cents per pound and its retail price 30 to 32 cents. It was said that good butter from the States had never been seen in St. Thomas, but an attempt has been made by at least one New York exporter to secure a market for a very poor article in 25-pound tins at 25 cents per pound retail. It was complained that American butter was not uniform and would not keep well.

Little or no cheese is made in St. Thomas and little is imported. European cheeses, weighing 8 to 9 pounds, are sold at 24 cents per pound retail and cheese from Halifax and the United States at 20 cents. These latter are said to be poor keepers, their chief fault being that they soon swell. The price of cheese fluctuates according to the quantity on the market and the demand. From May to August it is crowded out to a large extent by fruit. When it becomes old it is sold for use in macaroni.

The following statistics show the extent of the trade in dairy products:

TABLE 14.—*Imports of butter and oleomargarine into Danish West Indies from the United States, fiscal years 1892 to 1901.*

Year.	Butter.		Oleomargarine.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
1892	185,266	27,536	6,170	787
1893	131,105	22,672	73,480	9,371
1894	89,948	17,275	108,620	14,193
1895	63,022	9,736	97,550	11,386
1896	62,263	8,071	102,890	11,131
1897	51,625	6,318	95,400	9,134
1898	72,289	8,771	108,975	9,711
1899	35,293	5,069	124,450	10,135
1900	19,448	3,226	116,890	8,530
1901	16,760	2,875	115,090	9,523

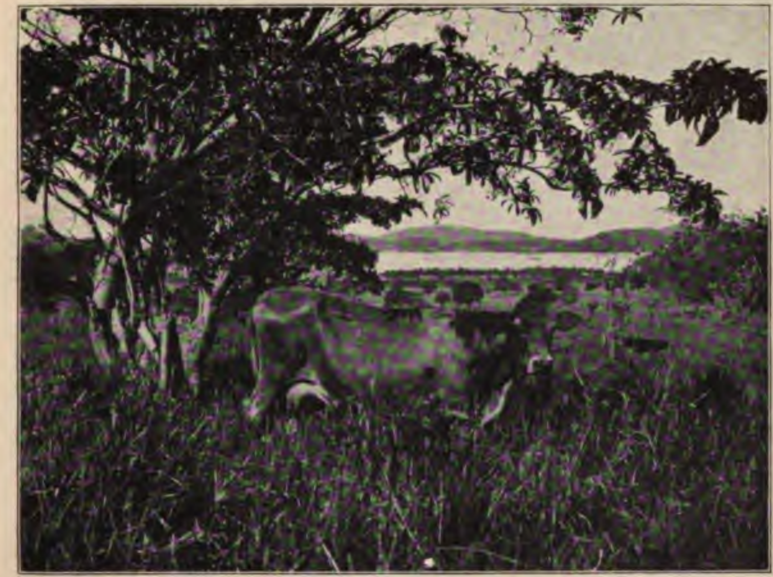

FIG. 1.—MILCH COW IN ST. THOMAS.

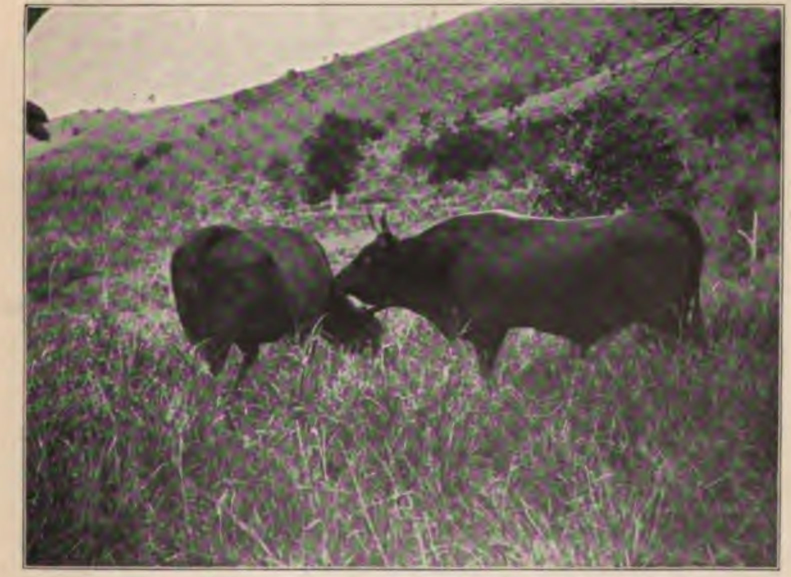

FIG. 2.—BULL AND COW IN ST. THOMAS.

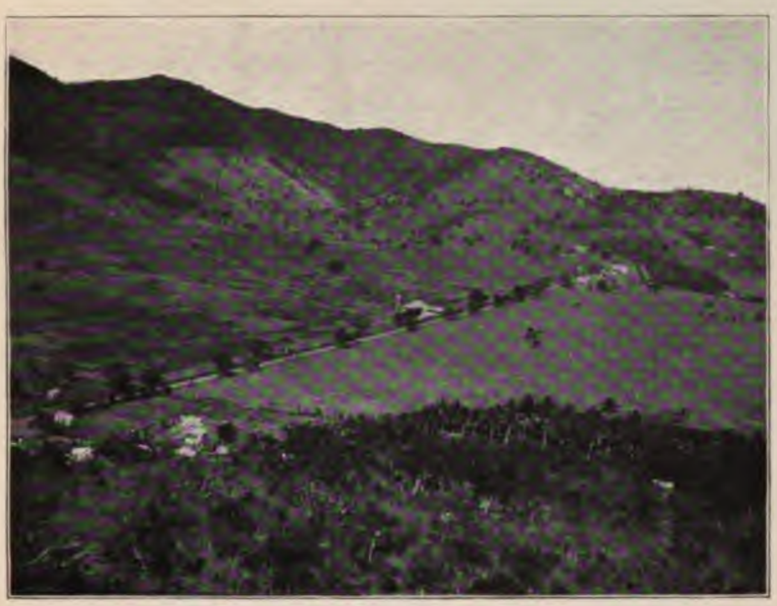

FIG. 1.—LANDSCAPE, ST. THOMAS.

Showing excellent pastures, farm buildings, and windmills.

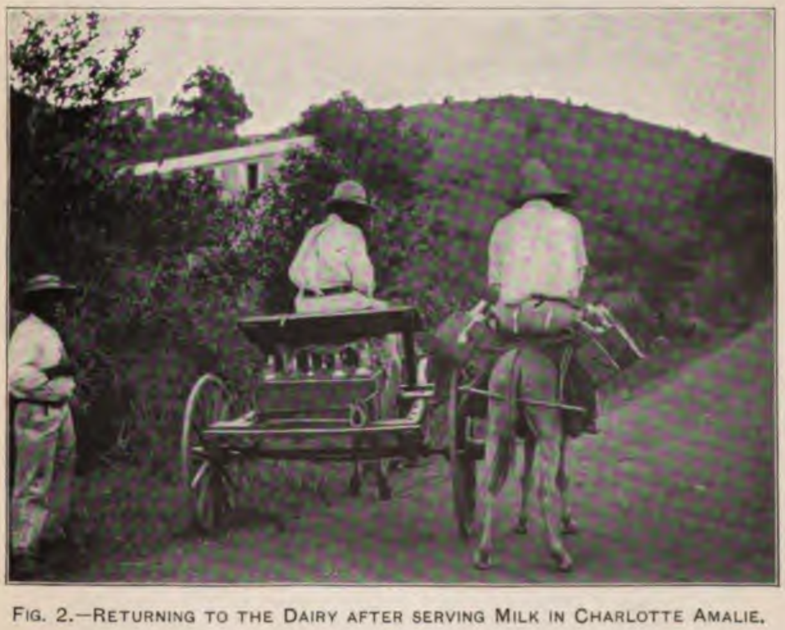

FIG. 2.—RETURNING TO THE DAIRY AFTER SERVING MILK IN CHARLOTTE AMALIE.

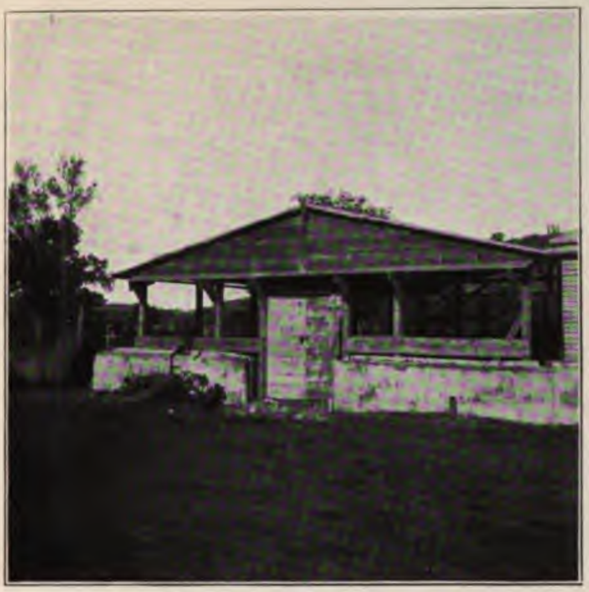

FIG. 1.—COW SHED IN ST. THOMAS.

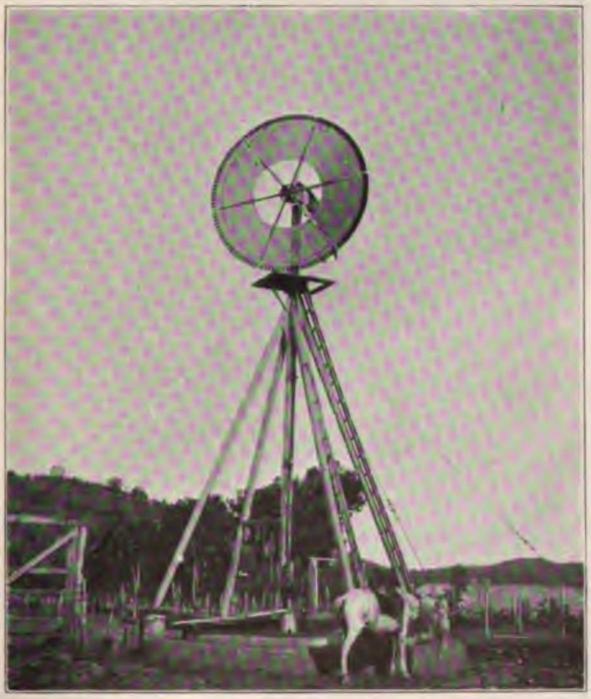

FIG. 2.—WINDMILL IN ST. THOMAS.

TABLE 15.—*Imports of butter, margarine, and cheese into St. Thomas, Danish West Indies, during year ended March 31, 1901, by countries.*

Countries.	Butter and margarine.		Cheese.	
	Quantity.	Value.	Quantity.	Value.
	Cases.	*Dollars.*	*Cases.*	*Dollars.*
Denmark	[a] 91	3,227	1	4
Germany	[a] 30	946	2,516	5,239
	[b] 5	58		
Great Britain			12	49
Holland			5	51
Belgium			1	2
France	[a] 1	37	3	11
United States	[a] 77	1,165	306	848
	[b] 622	5,105		
British Possessions in North America	1,509	5,943	193	999
British West Indies			1	1
Danish West Indies	([a])	6		

[a] Butter. [b] Margarine.

TABLE 16.—*Imports of butter (and margarine) and cheese into St. Croix, 1885 to 1894.*

Years ended March 3.	Butter.					Cheese.				
	Other Danish West Indies.	Denmark.[a]	United States.	Other countries.	Total.	Other Danish West Indies.	Denmark.[a]	United States.	Other countries.	Total.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1885	10,697	61		9,289	20,047	2,583	64		1,374	4,021
1886	10,212	267		14,802	25,281	2,460	58		2,355	4,873
1887	6,788	170		14,966	21,924	1,910			3,137	5,047
1888	4,780	85		16,482	21,347	1,653	2		3,426	5,081
1889	4,756	240		13,299	18,295	1,788	1		3,167	4,956
1890	4,378	609		21,093	26,080	1,525			4,780	6,305
1891	2,933	786	17,730	3,688	25,137	1,177	6	3,605	1,021	5,809
1892	2,798	900	15,978	868	20,544	1,233		2,569	225	4,027
1893	1,372	436	21,647	2,084	25,539	805	1	3,573	531	4,910
1894	2,502	200	20,906	2,808	26,416	900		4,425	997	6,322

[a] Including merchandise imported direct from Denmark as well as via St. Thomas.

DAIRY CONDITIONS IN CUBA.

A brief time only was spent in Cuba, and no special attempt was made to note agricultural conditions. These conditions were unnatural on account of the long period of war, but improvement throughout the island was reported. Special acknowledgment is made of courtesies of Governor Leonard Wood, Gen. Tasker H. Bliss, in charge of customs, P. H. Bristow, of the Post-Office Department, and other Government officials.

CATTLE.

It is claimed that Cuba is an excellent stock country, and some persons go so far as to predict that in the future beef will be sent from there to the markets of the United States. At the present time, however, owing to the heavy losses of stock during the war, not enough cattle are raised for home use, and it is necessary to import large numbers. It is stated on good authority that in 1899 there were only about one-sixth as many cattle in Cuba as there were prior to the war of 1894 (Tables 17, 18, and 19, which are from reports of the War Department). Most of the imports are of working animals of the same general type as the native Cuban cattle. The best of them come from Porto Rico, but many are brought also from Mexico, Venezuela, and Colombia. When imported these animals weigh from 700 to 900 pounds. A yoke of good oxen is worth about $110. Recently large numbers of Mexican cattle have been imported by the Government and distributed at cost (about $30) on easy terms to the farmers in certain districts where the cattle were practically all destroyed during the war. They were inferior in many ways, but generally docile and the same kind of animals the Cubans had been accustomed to.

TABLE 17.—*Number of horned cattle in Cuba, 1899.*

TOTAL ON ISLAND.

Province.	Oxen.	Calves.	Steers.	Bulls.	Heifers.	Young bulls.	Cows.	Yearling calves.
Habana	33,233	10,044	1,640	4,566	2,910	18,584	18,965	2,109
Matanzas	28,494	4,807	775	962	1,391	2,634	8,944	1,782
Pinar del Rio	38,965	4,884	1,227	1,514	1,751	2,782	9,881	1,710
Puerto Principe	6,140	7,657	3,008	2,296	2,488	1,217	15,232	4,504
Santa Clara	45,231	10,256	2,863	2,104	2,264	7,614	21,824	4,612
Santiago de Cuba	12,885	3,556	1,201	1,837	1,562	3,294	7,492	959
Total	164,948	41,204	10,714	13,279	12,366	36,125	82,338	15,676

ON FARMS.

Province.	Oxen.	Calves.	Steers.	Bulls.	Heifers.	Young bulls.	Cows.	Yearling calves.
Habana	28,884	7,367	1,251	2,979	2,294	11,639	14,215	1,738
Matanzas	21,607	2,713	412	562	849	1,099	4,917	1,068
Pinar del Rio	33,858	4,160	1,078	1,334	1,558	2,235	8,353	1,476
Puerto Principe	4,837	5,932	2,386	1,657	1,946	887	12,036	3,665
Santa Clara	37,722	6,442	1,844	1,350	1,725	5,213	14,111	3,035
Santiago de Cuba	9,360	1,859	681	862	910	266	3,164	560
Total	136,268	28,473	7,652	8,744	9,282	21,339	56,796	11,542

NOT ON FARMS.

Province.	Oxen.	Calves.	Steers.	Bulls.	Heifers.	Young bulls.	Cows.	Yearling calves.
Habana	4,349	2,677	389	1,587	616	6,945	4,750	371
Matanzas	6,887	2,094	363	400	542	1,535	4,027	714
Pinar del Rio	5,107	724	149	180	193	547	1,528	234
Puerto Principe	1,303	1,725	622	639	542	330	3,196	839
Santa Clara	7,509	3,814	1,019	754	539	2,401	7,713	1,577
Santiago de Cuba	3,525	1,697	520	975	652	3,028	4,328	399
Total	28,680	12,731	3,062	4,535	3,084	14,786	25,542	4,134

TABLE 18.—*Live stock imported into the island of Cuba year ended December 31, 1900.*

Country of export.	Bovine cattle paying duty.					Bovine cattle for breeding purposes, free of duty.				Total bovine cattle imported.
	Bulls.	Cows.	Calves.	Steers.	Total.	Bulls.	Cows.	Calves.	Total.	
United States	4,747	18,292	9,563	42,634	75,236	39	96	15	150	75,386
Spain	....	2	1	....	3	....	....	....	....	3
England	2	....	....	....	2	....	....	....	....	2
Cayman Island	12	43	9	34	98	....	....	....	....	98
Colombia	4,884	7,933	2,798	44,493	60,108	....	....	....	....	60,108
Costa Rica	....	....	....	1,957	1,957	....	....	....	....	1,957
Haiti	1,927	35	....	1,009	2,971	....	....	....	....	2,971
Honduras	257	65	21	10,824	11,167	....	....	....	....	11,167
Jamaica	91	423	77	370	961	....	....	....	....	961
Mexico	5,396	11,045	6,153	66,241	88,745	....	....	....	....	88,745
Porto Rico	343	4,007	1,875	7,885	14,110	....	....	....	....	14,110
Santo Domingo	....	4	4	187	195	....	....	....	....	195
Venezuela	1,025	3,516	615	27,455	32,611	....	....	....	....	32,611
Total	18,594	45,365	21,116	203,089	288,164	39	96	15	150	288,314

Country of export.	Other animals.							
	Horses.	Mules.	Donkeys.	Sheep.	Swine.	Goats.	Others.	Total.
United States	4,939	3,139	17	497	27,765	....	254	36,611
Spain	1	....	....	....	....	....	6	7
France	....	....	....	....	....	....	1	1
England	....	....	....	....	....	....	3	3
Cayman Island	37	....	....	....	94	....	86	217
Colombia	40	22	2	....	89	....	7	160
Costa Rica	1	....	....	....	....	....	....	1
Haiti	487	11	8	250	25	31	....	812
Honduras	32	3	....	....	217	....	14	266
Jamaica	13	25	27	59	136	3	3	266
Mexico	4,771	1,271	89	19	270	....	9	6,429
Porto Rico	1,502	737	....	17	23	5	13	2,297
Santo Domingo	21	4	1	....	....	....	....	26
Venezuela	5	1	....	....	4	....	1	11
Canaries	....	....	....	....	....	4	....	4
Total	11,849	5,213	144	842	28,623	43	397	47,111

TABLE 19.—*Live stock imported into the island of Cuba for the months of January, February, March, and April, 1901.*

Country of export.	Bulls.					Cows.					Calves.				
	Jan.	Feb.	Mar.	Apr.	Total.	Jan.	Feb.	Mar.	Apr.	Total.	Jan.	Feb.	Mar.	Apr.	Total.
United States	130	349	81	498	1,058	839	434	444	261	1,978	420	248	194	258	1,120
Mexico	786	25	277	128	1,216	2,877	691	1,989	1,043	6,600	1,124	353	1,372	994	3,843
Colombia	213	641	299	231	1,384	1,704	1,275	984	472	4,435	497	783	302	113	1,695
Venezuela	1,498	519	345	275	2,637	686	559	775	1,221	3,241	58	98	198	245	599
Porto Rico	426	.....	117	7	550	597	207	671	114	1,589	227	134	412	107	880
Honduras	3	90	.....	.....	93	19	.....	.....	.....	19	16	.....	.....	.....	16
Haiti	394	26	.....	.....	420	.....	.....	.....	.....	.....	.....	.....	1	.....	1
Jamaica	1	1	.....	.....	2	13	5	9	33	60	.....	2	.....	6	8
Cayman Islands	6	.....	2	.....	8	4	.....	12	.....	16	6	.....	9	.....	15
Total	3,457	1,651	1,121	1,139	7,368	6,739	3,171	4,884	3,144	17,938	2,348	1,618	2,488	1,723	8,177

TABLE 19.—*Live stock imported into the island of Cuba for the months of January, February, March, and April, 1901*—Continued.

Country of export.	Steers.					Other animals.					Total all animals.
	Jan.	Feb.	Mar.	Apr.	Total.	Jan.	Feb.	Mar.	Apr.	Total.	Four months.
United States	345	892	472	849	2,558	1,350	2,614	1,467	1,751	7,182	13,896
Mexico	6,811	5,110	4,667	3,934	20,522	903	484	512	350	2,249	34,430
Colombia	161	2,676	4,456	4,117	11,410	47	4	5	14	70	18,994
Venezuela	5,023	6,680	5,216	6,574	23,493	3	14	5	38	60	30,030
Porto Rico	451	103	355	175	1,084	318	248	508	490	1,564	5,667
Honduras	552	......	......	1,578	2,130	......	36	......	......	36	2,294
Haiti	......	42	......	......	42	68	101	150	71	390	853
Jamaica	14	9	3	27	53	26	9	6	7	48	171
Cayman Islands	3	......	......	......	3	25	......	14	......	39	81
England	......	......	......	......	......	......	2	......	......	2	2
Total	13,360	15,512	15,169	17,254	61,295	2,740	3,512	2,667	2,721	11,640	106,418

The methods of caring for cattle and working them are practically the same as in Porto Rico (Pl. LX).

Some cattle are imported from the States, but they are not in great demand. They are often wild and they are not suited to the Cuban method of yoking by the horns, and are therefore not available for the principal use made of them, namely, working. Those imported are used for beef and for milk production. Quite a number of Florida cattle are sent to Cuba. They are small and poor in flesh, weighing about 500 pounds. It is said they quickly adjust themselves to the new conditions and rapidly increase in weight, making good beef. Their cost in Cuba is about $23. Beef cattle are sent to Cuba also from other States. Some individuals do not thrive but require considerable time to become acclimated, and some become sick and die. As would be expected, the trouble is principally with cattle from north of the Texas fever line.

Cows from the States are often seen in dairies near the larger cities. Some of them do well and some do not. A few importers have made the serious mistake of taking cows to Cuba from the Northern States and they have suffered heavy losses on this account. A wealthy planter took to southern Cuba 15 cows which he said had cost $150 each in New York and $50 each for transportation. Soon after their arrival 10 of them died of Texas fever. When Northern cows are confined and carefully fed and cared for they usually remain healthy, but as soon as they are put on pasture or neglected they are in great danger of exposure to the ticks and to Texas fever. During the war, American cattle were kept about a year in Santiago (their milk sometimes selling as high as a dollar a gallon). They were fed hay and grain from the North. It is reported that some of them died, but the calves usually did well. Several herds of imported American milch cows are in Habana in buildings which on the outside appear almost the same as

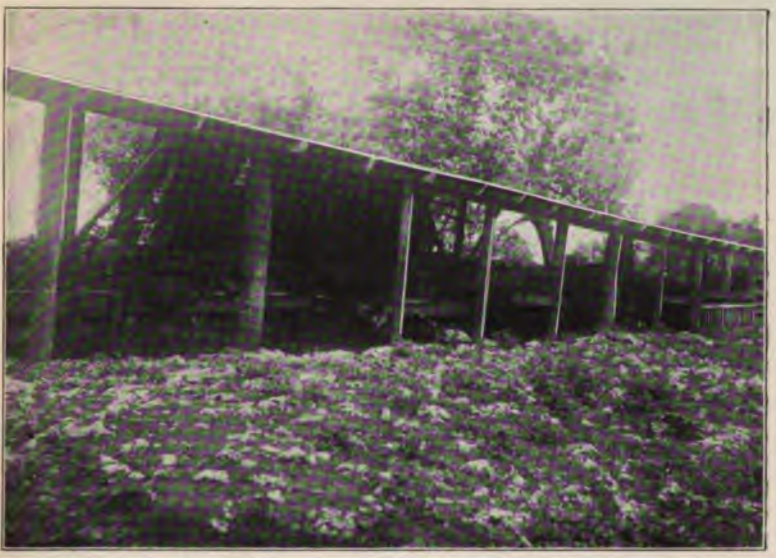

FIG. 1.—COW SHED NEAR HABANA, CUBA.

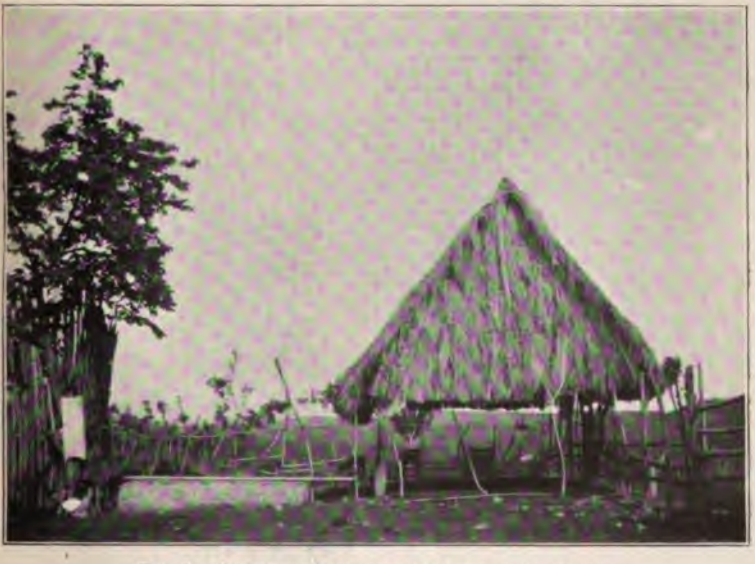

FIG. 2.—DAIRY ON SAN JUAN HILL NEAR SANTIAGO.

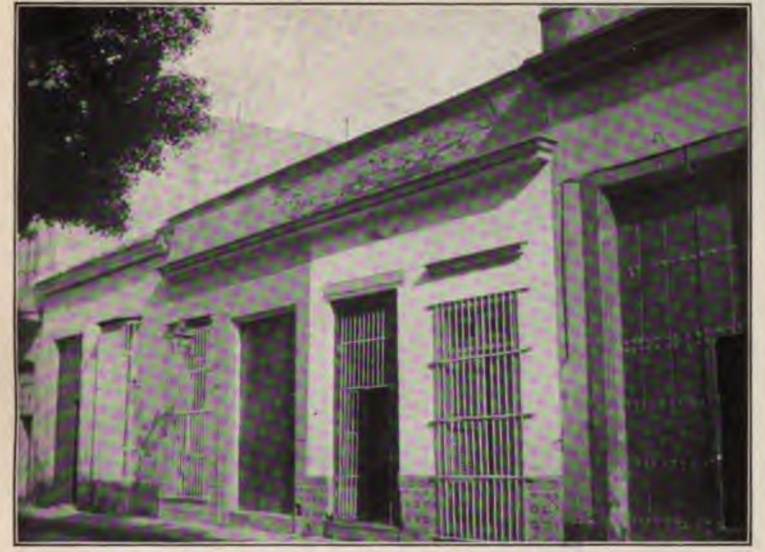

FIG. 1.—DAIRY IN HABANA, CUBA.

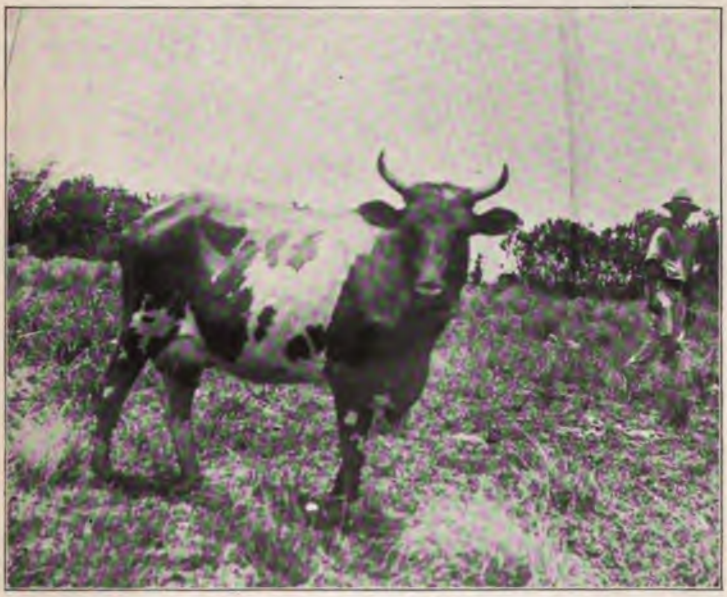

FIG. 2.—MILCH COW IMPORTED FROM ALABAMA.

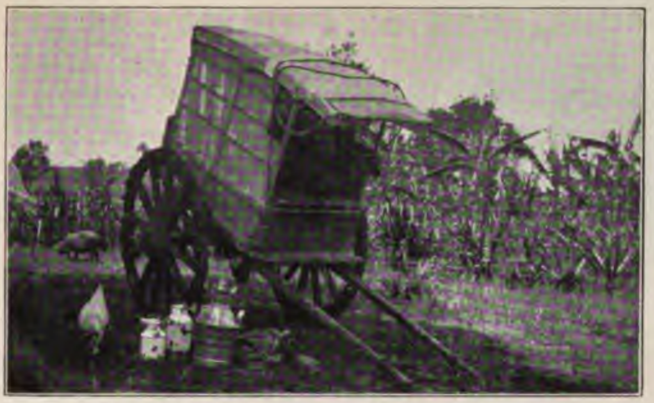

FIG. 1.—CART FOR CARRYING MILK TO HABANA.

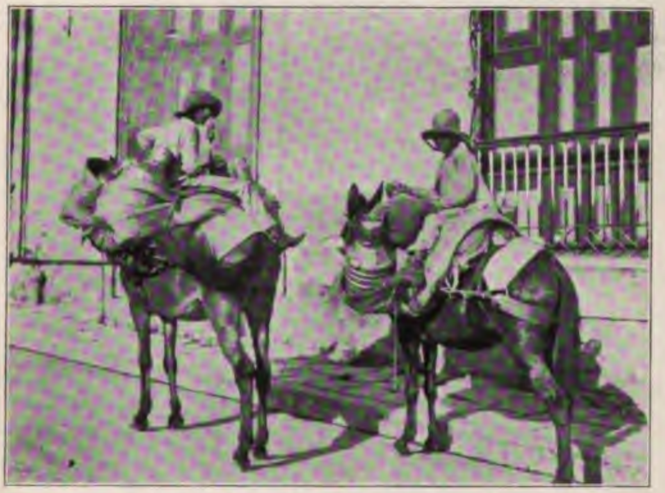

FIG. 2.—DELIVERING MILK IN SANTIAGO.

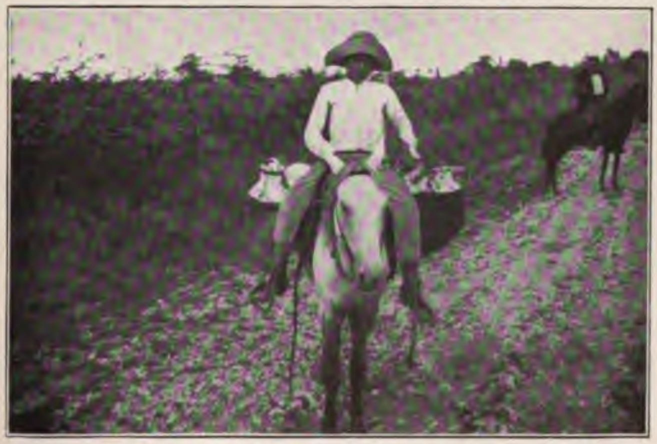

FIG. 3.—TAKING MILK TO A SMALL CUBAN TOWN.

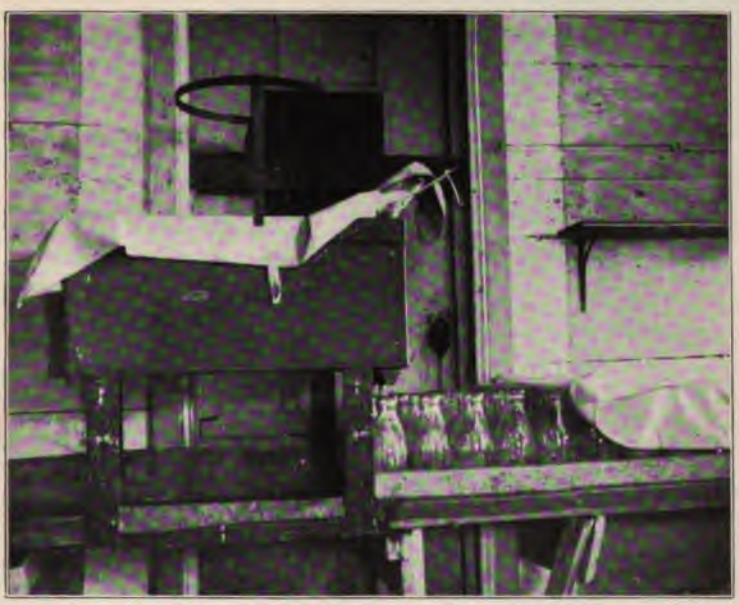

FIG. 1.—MODERN EQUIPMENT FOR BOTTLING MILK NEAR CIENFUEGOS, CUBA.

FIG. 2.—IMPORTED CHEESE ON THE WHARF AT SANTIAGO.

residences (Pl. LXI, fig. 1). These cows get little outdoor exercise. Green fodder and bran are given to them and they are bathed daily.

Although it is reported that milch cows from the Southern States often become sick, it is believed that the danger of loss among such cattle is much less than many suppose. Some cattle are credited as having come from the South when they have simply passed through the South en route to Cuba. A cow from Alabama was seen (Pl. LXI, fig. 2) which was 6 years old, had been in Cuba three years, and had never been sick. She was milked but once a day, when she gave 10 quarts or more, and was said to be worth $100 in Spanish gold.

The import duty on cows is $2 each. Land suitable for dairy purposes near Habana is worth from $30 to $50 per acre. Freight rates on small shipments of cattle from the United States are high.

MARKET MILK.

The milk business throughout the island is conducted in about the same manner as in Porto Rico. Porto Rican cows are generally favored, and high prices are often paid for them. A dairyman near Santiago claimed to have paid $70 for a Porto Rican cow which yielded about 5 quarts per day. As stated above, American cows are found in dairies near cities. Over $100 is sometimes paid for good ones, the price varying between wide limits, according to the supply and demand. Unfortunately, the introduction of American cows does not necessarily include the introduction of American methods. Many good Holstein, Jersey, and Durham grade cows are managed in the same way as native Cubans. It is a strange sight to see these highly developed and well-trained creatures being cared for in such a primitive manner, which includes the single daily milking, use of the calves to "start" the milk, etc.

In a few dairies some advance has been made toward American methods; for example, the cows may be milked twice daily, but even then the calves are usually allowed to assist. In a dairy near Cienfuegos a complete milk bottling outfit was found (Pl. LXIII, fig. 1). The milk was bottled and delivered without cooling as soon as possible after being drawn. Sterilized milk is used to a limited extent. Near Habana a small dairy was visited where there were a dozen American grade Jersey and Holstein cows that had been brought from Texas. They were cared for by their owner, an American, and were yielding him good return for his investment and labor. He reported a net profit of $200 on seven cows in four and one-half months. They were milked two times a day (without the calves) and averaged 10 quarts each daily; they had never been sick. Feed was purchased for these cows at the following rates: Bran, 100 pounds, $1.60 Spanish gold; shelled corn, 100 pounds, $1.80 Spanish gold; Cuban hay, very coarse, 70 pounds for 50 cents Spanish gold.

Prices of milk range between wide limits. In Habana it is commonly sold at 10 to 15 cents per liter (a little more than a quart). In Santiago the price is higher. In small towns the price may be as low as 3 or 4 cents per quart when milk is plentiful and as high as 12 or 15 cents when scarce, as it is in the dry season. The capacity of measures often varies almost as much as the prices. One dealer was found to be using for a quart measure a bottle holding only 17 ounces (Pl. LXII).

In connection with the subject of city milk supply mention should be made of a peculiar custom which was observed in Habana. Asses' milk is used there in small quantity, especially by the sick, and every morning numbers of female asses are driven through the streets for the purpose of serving the product fresh. A man or boy has charge of from two to six of these animals, which will give from 1 to 3 pints of milk each. They are stopped before houses where their milk is wanted and it is drawn in the presence of the customer. The price of the milk is as high as 40 cents per pint, hence its use is greatly restricted. It is supposed to have much merit as a food for the sick.

NATIVE BUTTER AND CHEESE.

But little butter is made in Cuba, and it is generally inferior. An article of surprisingly good quality, however, was found in the town of Manzanillo, having been produced in a dairy nearby where ice is available. It was retailed for 50 cents per pound.

As in Porto Rico, cheese is made in considerable quantity in country districts where milk is available. It is said to be produced in Neuvitas, Principe, and elsewhere, and the product of some dairies is claimed to be a superior article. Unfortunately, time did not permit a visit to any of these places for the observation of methods, but from reports given the writer it is judged that the methods were crude. The native cheese must be sold while fresh, as it will not keep a long time. The retail price is as high as 18 cents.

IMPORTED BUTTER.

Butter in Cuba has been largely replaced by cheap oleomargarine from the States. The latter is commonly sold and referred to as butter, though each package is required to be labeled when imported; the retailer sells at 15 to 20 cents per pound an article that cost him 10 to 12 cents, and many persons think it is an inferior American dairy product. It is in tins holding one-half, 1, 4, or 8 pounds. A high-grade oleomargarine in prints resembling butter prints is sold in small quantity at 35 cents per pound. It arrives in refrigeration with fresh meats and is kept on ice.

The character of the butter imported in tins and the method of handling it are about the same as seen in Porto Rico. A few new brands were found, and some of those prominent in Porto Rico were missing. Prices were about the same as on the other island, but in some instances a little lower. Effort has been made to introduce some very inferior tinned butter from the States, but with little success. Merchants receiving such shipments say there is no market for goods of that character. A poor grade of States butter in tins was found on sale at 35 to 40 cents retail. One merchant complained that while he was trying to introduce a medium grade of tinned butter from the States the shipper of that brand commenced to send into his city a cheaper butter in the same package, which, of course, promptly killed the trade he had developed.

Good American print and roll butter and a little in tubs is sold in a few places in Habana and Santiago, some of it arriving in refrigeration and frequently with dressed meats, the two articles being shipped by the same concern, which also controls the refrigerators. Its price at retail is 40 to 50 cents. Some Georgia butter was on sale in a Habana store. Its texture was more stiff than ordinary and it was slightly sticky, but "stood up" quite well, which peculiar characteristics are supposed to be due to cotton-seed meal fed to the cows. A grocer and restaurant keeper in Santiago used to import from New York high-grade butter in refrigeration with fruit and retailed it for 70 cents per pound, principally to a few of the 500 Americans in that city. It is reported that many Cubans who formerly did not use butter are now taking considerable quantities of the best grades. This is a statement of much significance, and is in accord with the fact frequently observed that when Cubans are in the States they use butter three times a day, but seldom taste it in Cuba because they can not get a good article. This is encouragement for those who wish to introduce butter of high grade.

The composition and prices of a few brands of butter and oleomargarine purchased in Cuba are shown in table 6. The extent of the imported butter business may be judged by an examination of the statistics of imports. (Tables 20, 23, 24, and 25.)

Leading merchants both in Santiago and Habana expressed a desire to receive small trial shipments of high-grade American butter in hermetically sealed packages, and some emphasized strongly the necessity of full weight in each package.

Artificial ice is available in the larger cities at prices below those asked in Porto Rico. In Santiago it is sold at 50 cents per 100 pounds; in Habana as low as 30 cents. It is not generally used in grocery stores where butter is sold.

IMPORTED CHEESE.

The best cheese is imported, several forms coming from Europe (part of it by way of New York) (Pl. LXIII, fig. 2); but a large share of the total is made in the United States and Canada. Swiss cheese is said to cost at wholesale 20 to 25 cents per pound, and it retails for 30 to 35 cents. One of the leading Habana merchants claims to handle about 1 ton of Swiss cheese each week, and a Santiago merchant claimed to handle about 1 ton a month. A little Roquefort was found on sale at 50 to 60 cents retail. Holland, or Gouda, cheeses, weighing about 7 pounds each, cost the retailer 17 to 25 cents per pound, and he sells them for 20 to 35 cents. The price varies according to the quantity on the market, and in times of shortage it is very high. They come four in a box, and sometimes each is inclosed in a bladder skin or tin box for additional protection. Their good qualities are retained remarkably well, but in hottest weather dealers try to dispose of them within three or four weeks after receipt. Canadian cheese is received in 50-pound sizes, while much from the United States is in the form of Young Americas, and some is said to be imitation Gruyère. A lot of American colored cheese, costing 11 cents in New York, was sold to the retailer in Santiago at 20 cents, and he disposed of it at 30 cents. Considerable quantities of this cheese are used on the large sugar and tobacco estates. It is not held in high favor, as it does not keep well. An American imitation of Gouda cheese was favorably mentioned (tables 21, 23, 24, and 25).

CONDENSED MILK.

Condensed milks of both American and European origin were seen in most of the better grocery stores. This article needs no further comment than was given it in the part of the report devoted to Porto Rican conditions (tables 22, 23, 24, and 25.)

TABLE 20.—*Butter and oleomargarine imported into Cuba, March to December, 1899, and March to June, 1900.*

Year and month.	United States.		United Kingdom.		Spain.		Denmark.		Netherlands.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1899.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dolls.*
March	201,715	33,104	13,171	3,470	59,330	11,961	5,048	863	621	145
April	138,834	15,997	4,577	795	42,704	8,378	6,606	1,292	2,151	420
May	45,356	5,535	1,266	509	56,705	10,182	24,197	4,808	930	184
June	65,731	7,809	4,545	1,097	42,842	5,154	10,813	2,470	3,637	475
July	36,300	5,427	13,304	1,947	37,345	6,127	18,622	4,337	28	5
August	42,546	4,679	3,107	825	14,995	2,470	14,141	3,465	3,972	730
September	50,536	6,702	1,228	248	20,841	4,056	14,677	2,906	1,840	364
October	45,669	7,085	4,867	1,027	5,108	692	6,573	1,351	1,815	228
November	195,834	23,514	5,175	1,226	62,978	11,143	11,931	2,671	1,911	462
December										
1900.										
March	242,889	25,972	5,415	1,349	45,935	7,363	10,357	2,041	89	60
April	64,108	7,338	2,984	761	63,007	10,198	951	183	371	100
May	42,399	4,164	1,680	394	37,460	6,373	7,777	1,790	1,858	455
June	85,621	8,794	1,450	268	23,075	4,003	3,531	845	4,282	635

TABLE 20.—*Butter and oleomargarine imported into Cuba, March to December, 1899, and March to June, 1900*—Continued.

Year and month.	France.		Germany.		Norway and Sweden.		Other countries.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1899.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dolls.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
March	1,751	298	2,231	382	....	....	9	2	283,876	50,225
April	....	....	....	....	....	....	....	....	194,872	26,882
May	644	95	....	....	....	....	....	....	129,098	21,313
June	276	58	....	....	....	....	....	....	127,844	17,063
July	....	....	....	....	....	....	2	1	105,602	17,844
August	662	135	....	....	3,500	835	....	....	82,923	13,139
September	....	....	4	1	....	....	....	....	89,126	14,277
October	1,053	142	3,366	666	1,537	194	....	....	69,988	11,385
November December	1,123	182	5,063	1,203	....	....	....	....	284,015	40,401
1900.										
March	66	20	....	....	....	....	....	....	304,751	36,805
April	424	56	....	....	....	....	3,084	736	134,929	19,372
May	8,700	1,937	....	....	....	....	64	4	99,938	15,117
June	484	101	7,256	1,723	....	....	....	....	125,699	16,359

Butter imported into Cuba, July to October, 1900.

Year and month.	United States.		United Kingdom.		Spain.		Denmark.		Netherlands.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1900.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
July	69,900	6,734	5,156	1,180	39,752	7,305	8,181	1,960	1,440	140
August	35,886	4,790	6,120	1,435	11,903	2,095	14,548	3,523	....	....
September	27,365	3,047	6	1	14,029	2,382	4,395	1,052	....	....
October	3,104	570	1,766	465	12,298	2,523	3,484	935	2,395	495

Year and month.	France.		Italy.		Germany.		Belgium.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1900.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
July	235	24	1,266	252	....	....	....	....	125,930	17,595
August	654	130	....	....	....	....	....	....	69,111	11,973
September	1,048	181	....	....	266	16	180	24	47,289	6,703
October	....	....	....	....	....	....	....	....	23,047	4,988

Oleomargarine imported into Cuba, July to October, 1900.

Year and month.	United States.		United Kingdom.		Germany.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1900.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
July	17,717	1,543	....	....	....	....	17,717	1,543
August	44,189	3,854	....	....	....	....	44,189	3,854
September	4,294	312	....	....	1,370	57	5,664	369
October	72,100	6,802	1,520	390	....	....	73,620	7,192

TABLE 21.—*Cheese imported into Cuba, March to December, 1899, and March to October, 1900.*

Year and month.	United States.		United Kingdom.		Spain.		Netherlands.		France.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1899.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dolls.*
March	168,265	19,996	42,476	4,447	15,788	2,871	232,296	23,176	282	52
April	104,480	12,632	36,444	3,580	12,048	3,039	362,540	38,499	2,825	404
May	76,587	8,726	23,393	3,039	6,442	873	192,275	26,748	5,866	698
June	42,951	5,693	31,774	3,712	3,295	465	173,656	18,804	1,320	195
July	76,392	9,255	15,270	1,723	9,175	738	110,600	13,488	9,065	107
August	63,530	7,089	21,460	2,485	4,293	578	445,506	39,755	2,401	260
September	95,932	17,717	55,008	11,291	1,184	319	232,396	61,506	1,746	471
October	46,263	8,359	66,442	12,996	315	53	307,221	33,006	3,693	391
November December	90,282	12,115	44,612	4,908	5,434	1,021	516,029	61,438	7,238	940
1900.										
March	65,491	8,955	46,406	6,091	28,864	1,951	291,197	36,936	309	51
April	49,924	7,107	33,804	4,641	25,061	3,865	310,665	42,788	670	97
May	38,908	5,131	41,156	5,746	8,397	1,095	201,672	26,680	220	33
June	46,470	5,537	28,634	4,391	9,055	1,569	226,696	25,253	2,024	248
July	36,277	4,754	57,889	7,252	3,244	469	271,545	29,015	352	39
August	26,004	3,524	46,899	5,618	2,755	651	233,930	26,973	1,568	184
September	31,133	4,282	36,828	4,427	1,262	149	145,612	25,882	2,732	355
October	31,008	4,397	28,616	3,359	4,965	741	88,516	10,193	2,173	301

Year and month.	Germany.		Switzerland.		Colombia.		Other countries.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1899.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dolls.*
March	1,978	119	....	....	373	69	....	....	461,458	50,730
April	....	....	....	....	2,410	520	10,662	1,277	531,409	59,951
May	....	....	....	....	....	....	....	....	304,563	40,084
June	....	....	....	....	....	....	....	....	252,996	28,869
July	....	....	....	....	1,022	120	....	....	221,524	25,431
August	10,853	1,146	....	....	....	....	....	....	548,043	51,313
September	10,971	1,252	....	....	5,781	1,419	2,633	1,111	405,651	95,086
October	1,408	380	....	....	....	....	19,110	2,360	444,452	57,545
November December	6,452	828	....	....	....	....	935	245	670,982	81,495
1900.										
March	3,717	462	....	....	....	....	....	....	435,984	54,446
April	100	16	....	....	....	....	....	....	420,224	58,514
May	1,560	192	....	....	....	....	215	6	292,123	38,883
June	....	....	3,528	540	....	....	15	2	316,422	37,540
July	....	....	1,920	320	....	....	286	39	371,513	41,888
August	391	73	....	....	....	....	466	93	312,013	37,116
September	1,590	185	1,577	238	....	....	....	....	220,734	35,518
October	2,008	312	2,400	405	....	....	510	171	160,196	19,879

TABLE 22.—*Condensed milk imported into Cuba, July to October, 1900.*

Year and month.	United States.		United Kingdom.		Norway and Sweden.		France.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1900.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
July	430,435	26,305	41,425	2,319	24,173	1,320	933	65
August	575,450	35,612	95,440	5,676	80,755	4,284	....	....
September	417,625	26,855	134,773	7,694	35,466	1,879	....	....
October	506,042	30,522	131,497	7,536	38,702	2,387	3,713	182

Year and month.	Netherlands.		Germany.		Belgium.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1900.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
July	1,500	91	....	....	....	....	498,466	30,100
August	....	....	....	....	....	....	751,645	45,572
September	....	....	....	....	79	4	587,943	36,432
October	....	....	123	11	....	....	680,077	40,658

TABLE 23.—*Butter, cheese, condensed milk, and oleomargarine imported into the island of Cuba.*

SIX MONTHS ENDED DECEMBER 31, 1900.

Country of export.	Butter.		Cheese.		Condensed milk.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
United States	153,028	$17,273	200,931	$28,199	2,925,381	$187,878
Spain	121,225	22,496	20,317	3,526	....	....
France	2,699	473	23,977	2,889	8,231	416
Germany	266	16	27,239	3,642	130	13
United Kingdom	13,173	3,110	301,724	37,047	460,585	28,476
Other American countries	....	....	796	210	....	....
Other European countries	38,523	10,310	1,244,157	155,065	219,538	12,051
Total	328,914	53,678	1,819,141	230,578	3,613,865	228,829

THREE MONTHS ENDED MARCH 31, 1901.

Country of export.	Butter.		Cheese.		Condensed milk.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
United States	26,038	$4,483	104,229	$15,108	1,772,575	$112,851
Denmark	17,522	4,402	....	....	....	....
France	1,351	281	17,099	2,377	3,202	140
Germany	2,652	367	31,270	4,547	....	....
Netherlands	3,946	1,073	558,814	68,407	....	....
Norway	....	....	....	....	128,738	6,763
Spain	68,435	11,738	27,560	3,022	....	....
Switzerland	....	....	....	....	299	18
United Kingdom	458	150	103,837	13,241	300,600	17,503
Total	120,402	22,494	842,809	106,702	2,205,414	137,276

TABLE 23.—*Butter, cheese, condensed milk, and oleomargarine imported into the island of Cuba*—Continued.

SIX MONTHS ENDED DECEMBER 31, 1900.

Country of export.	Oleomargarine.		Total.	
	Pounds.	Value.	Pounds.	Value.
United States	287,953	$27,038	3,567,293	$260,383
Spain	....	....	141,542	26,022
France	....	....	34,907	3,778
Germany	1,370	57	29,005	3,728
United Kingdom	1,520	390	777,002	69,023
Other American countries	....	....	796	210
Other European countries	3,706	875	1,505,924	178,301
Total	294,549	28,360	6,056,469	541,445

THREE MONTHS ENDED MARCH 31, 1901.

Country of export.	Oleomargarine.		Total.	
	Pounds.	Value.	Pounds.	Value.
United States	285,392	$26,072	2,188,234	$158,514
Denmark	635	171	18,157	4,573
France	376	48	22,028	2,846
Germany	....	....	33,922	4,914
Netherlands	2,153	210	564,913	69,690
Norway	....	....	128,738	6,763
Spain	23,566	4,190	119,561	18,950
Switzerland	....	....	299	18
United Kingdom	2,847	392	407,742	31,286
Total	314,969	31,083	3,483,594	297,554

TABLE 24.—*Butter and oleomargarine imported into the port of Habana, Cuba, fiscal year ended June 30, 1900.*

Months.	United States.		Spain.		Denmark.		United Kingdom.		France.	
	Pounds.	Value.	Pounds	Value.	Pounds	Value.	Pounds	Value.	Pounds	Value.
1899.										
July	11,657	$1,899	37,346	$6,127	18,622	$4,337	8,457	$1,826	....	....
August	5,023	899	10,928	1,572	11,331	2,758	2,517	686	662	$135
September	13,244	2,622	17,260	3,417	14,677	2,906	646	128	....	....
October	16,826	3,446	5,108	692	5,148	1,024	2,213	438	1,053	142
November	68,606	8,706	25,577	4,104	9,213	2,053	3,720	879	28	2
December	42,211	4,740	33,737	6,340	2,718	618	....	....	1,031	172
1900.										
January	33,275	4,940	28,693	4,864	10,082	4,277	2,597	588	264	40
February	49,722	6,258	38,366	6,466	1,793	440	2,535	630	2,126	516
March	122,515	12,422	42,144	6,760	3,013	650	2,924	732	66	20
April	40,448	4,507	54,822	8,647	704	177	2,984	761	424	56
May	14,640	1,744	34,981	5,908	6,686	1,630	....	....	8,455	1,916
June	50,842	5,224	23,075	4,003	3,531	845	....	....	....	....
Total	469,009	57,407	352,037	58,900	87,518	21,715	28,593	6,668	14,109	2,999

TABLE 24.—*Butter and oleomargarine imported into the port of Habana, Cuba, fiscal year ended June 30, 1900*—Continued.

Months.	Germany.		Holland.		Other countries.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1899.								
July	....	....	28	$5	[a] 2	$1	76,112	$14,195
August	....	....	2,000	520	[b] 3,500	835	35,961	7,405
September	....	....	1,840	364	....	....	47,667	9,437
October	3,366	$666	1,815	228	[b] 1,537	194	37,066	6,830
November	1,577	373	....	....	....	....	108,721	16,117
December	3,486	830	....	....	....	....	83,183	12,700
1900.								
January	3,717	761	1,584	405	....	....	80,212	15,875
February	1,815	445	1,644	350	....	....	98,001	15,105
March	....	....	....	....	....	....	170,662	20,584
April	....	....	371	100	[c] 2,380	559	102,133	14,807
May	....	....	1,858	455	[d] 64	4	66,684	11,657
June	....	....	2,522	210	....	....	79,970	10,282
Total	13,961	3,075	13,662	2,637	7,483	1,593	986,372	154,994

[a] Italy. [b] Norway. [c] Belgium. [d] Mexico.

TABLE 25.—*Butter, cheese, milk, and oleomargarine exported to Cuba from the United States, quantities and values, 1852 to 1901.*

Year ended June 30—	Butter.		Cheese.		Milk.	Oleomargarine.	
	Pounds.	Value.	Pounds.	Value.	Value.	Pounds.	Value.
1852	420,597	[a] $77,862	339,162	([a])	....	....	....
1853	366,158	[a] 75,857	156,021	([a])	....	....	....
1854	469,857	[a] 94,446	214,904	([a])	....	....	....
1855	295,406	53,840	170,886	$19,510	....	....	....
1856	391,857	73,849	136,831	14,330	....	....	....
1857	471,973	87,551	131,227	14,417	....	....	....
1858	660,731	117,117	245,134	25,346	....	....	....
1859	764,464	134,267	170,546	17,082	....	....	....
1860	762,589	119,062	200,120	22,083	....	....	....
1861	626,920	100,764	229,628	24,510	....	....	....
1862	711,110	101,487	459,916	37,718	....	....	....
1863	867,693	187,750	473,043	55,037	....	....	....
1864 [b]	943,630	252,709	829,812	109,187	$212	....	....
1865	608,153	241,962	190,689	38,006	[b] 2,236	....	....
1866	350,550	127,075	145,530	24,950	....	....	....
1867	531,131	144,253	187,625	25,599	....	....	....
1868	290,860	85,604	66,775	7,801	....	....	....
1869	211,757	70,115	56,487	8,574	....	....	....
1870	338,121	96,620	96,540	15,281	8,805	....	....
1871	345,362	86,503	152,512	19,601	6,525	....	....
1872	464,637	94,264	92,533	11,131	8,404	....	....
1873	338,914	72,838	81,626	11,437	6,459	....	....
1874	271,891	75,607	39,496	6,427	9,593	....	....
1875	325,472	83,428	86,464	13,007	8,049	....	....
1876	221,194	56,146	106,385	15,206	4,176	....	....
1877	428,659	93,267	106,567	14,338	4,746	....	....
1878	339,710	56,111	42,450	5,735	6,867	....	....

[a] Values for butter in 1852-1854 include those for cheese. [b] To Spanish West Indies.

TABLE 25.—*Butter, cheese, milk, and oleomargarine exported to Cuba from the United States, quantities and values, 1852 to 1901*—Continued.

Year ended June 30—	Butter.		Cheese.		Milk.	Oleomargarine.	
	Pounds.	Value.	Pounds.	Value.	Value.	Pounds.	Value.
1879	453,735	$62,166	128,761	$16,011	$13,816	....	....
1880	283,779	54,304	140,022	21,226	13,778	....	....
1881	306,950	54,515	71,555	12,113	14,797	....	....
1882	186,781	40,876	64,012	13,697	13,100	....	....
1883	196,839	44,339	72,008	15,580	11,967	....	....
1884	134,956	32,418	59,461	13,853	7,894	372	$53
1885	199,806	36,453	62,617	14,908	11,887	....	....
1886	264,770	45,202	89,737	16,120	14,144	1,800	182
1887	242,970	41,105	83,976	14,817	9,993	2,600	350
1888	168,536	30,266	81,148	14,135	13,013	88,500	10,834
1889	112,209	21,771	55,695	10,010	15,401	128,305	13,888
1890	143,433	21,219	62,708	9,686	22,193	56,360	7,113
1891	101,130	18,119	90,275	12,910	17,226	58,020	6,611
1892	165,833	33,570	202,611	27,478	27,298	66,397	7,528
1893	234,156	49,257	225,421	32,494	46,347	5,624	745
1894	121,179	27,038	215,021	30,835	41,732	4,300	538
1895	53,305	11,598	52,680	8,368	39,777	4,620	621
1896	49,982	10,080	42,896	7,508	63,852	....	....
1897	58,120	10,475	64,869	11,284	70,485	....	....
1898	42,715	8,087	219,531	25,888	114,230	250	25
1899	585,840	99,497	635,225	76,884	364,162	157,706	19,658
1900	255,473	45,469	334,428	42,077	442,610	516,463	60,666
1901	115,599	20,954	199,184	27,801	406,798	722,075	81,909

FACILITIES FOR SHIPPING.

Many steamships are operated between the United States and Cuba. The principal routes are from New York to Habana; New York to Matanzas (near Habana); New York to Santiago and Cienfuegos; Mobile to Habana; Mobile to Santiago; and Tampa, Fla., to Habana; and there are others. Most of the freight is shipped from New York, whence there is a sailing at least two or three days of each week, the time of fast steamers to Habana being about three days. Commercial refrigerators are not available. The freight rate on butter and cheese, New York to Habana, is 47 cents per 100 pounds. The minimum charge is $6. The rate from New York to Santiago is 42 cents and the minimum charge $5.25; sailing time, seven or eight days. On account of the high minimum rate small shipments of butter or cheese can not be forwarded independently except by the payment of a very heavy freight rate. The best way is to have them included with other goods going to the same destination, all being covered by one bill of lading. This would have to be done by arrangement with houses making regular shipments. When independent shipments are made it is the custom of American shippers to provide for immediate payment by the use of a sight draft attached to bill of lading.

The express rates from New York to any principal Cuban port and to other points are as follows:

	25 pounds.	50 pounds.	100 pounds.
Principal ports	$1.25	$2.00	$3.50
Other points	2.26	3.20	5.50

An executive order promulgated March 31, 1900, which took effect June 15, 1900, declared the tariff on butter and oleomargarine imported into Cuba to be $7 per kilogram, on cheese $5 per kilogram, and on condensed milk 10 per cent ad valorem; butter and cheese to be dutiable on gross weight, including the weight of all packages or receptacles, 12 per cent tare allowed on butter in ordinary boxes, tierces, cans, etc., 35 per cent tare allowed on butter in brine or otherwise packed, with wooden, glass, or tin receptacles combined, provided this does not exceed the actual tare; and 12 per cent tare allowed on cheese. This Department has pointed out to the proper authorities the great disadvantage of the above regulations to shippers of high-grade butter packed for protection against heat, which necessitates large tare, and it is advised of the intention hereafter to allow actual tare on butter arriving in unusual packages.

STATISTICS OF OLEOMARGARINE, OLEO OIL, AND FILLED CHEESE, 1900 AND 1901.[a]

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All the available statistics relating to the production and distribution of oleomargarine, oleo oil, and filled cheese which might be of public interest were published in tables in the Sixteenth Annual Report (1899) of the Bureau of Animal Industry, together with a discussion in which the requirements of the United States laws were stated, and the statistical data of chief importance were emphasized. With one or two exceptions the latest figures included were for the fiscal year ended June 30, 1899. Statistics for the two following fiscal years (1900 and 1901) are now presented, the sources of information, as before, being the Bureau of Internal Revenue and the Bureau of Statistics of the Treasury Department. A part of the data, which has not yet been published, has been kindly furnished through the Section of Foreign Markets of this Department. In some instances statistics of one or a few years previous to 1900 are given for purposes of comparison.

OLEOMARGARINE.

The largest output of oleomargarine[b] in any fiscal year since the oleomargarine revenue law took effect (1886) was during the twelve months ended June 30, 1900, and amounted to 107,045,028 pounds, an average of 8,920,419 pounds per month. This was an increase of about 29 per cent over the production in 1899, 86 per cent over that of 1898, and 135 per cent over the product of 1897. The revenue collections from oleomargarine in 1900 were $2,543,785.18. The production decreased very slightly in 1901, at the close of which year the total quantity of oleomargarine accounted for by the official records since November 1, 1886, was 859,598,873 pounds, upon which a total of $21,003,988.05 had been paid as taxes. As in earlier years, the greater part of the output in 1900 and 1901 was for home consumption, the exports amounting to less than 5 per cent of the production (table 1).

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[a] Also published as Senate Document No. 168, Fifty-seventh Congress, first session.

[b] In compliance with a resolution of the House of Representatives, the Secretary of the Treasury has furnished a statement of all the ingredients used in the manufacture of oleomargarine in the United States in the fiscal year 1899. This statement

Statistics of production and distribution of oleomargarine by months have not been published by the Treasury Department, but by special courtesy they have been furnished to this Bureau (table 2), and it is noted that quantities produced in different months varied about as in the years preceding 1900. The production appears to have an intimate relation to the price of butter, being greatest in the winter and smallest in the summer.

The manufacturers of oleomargarine in 1900 and 1901 were located in the same districts as in 1899, with the addition of Kentucky and Texas, which appear on the list of producing States for the first time, and Pennsylvania, which had not been on the list since 1895. Illinois continues to stand far in advance of all others in quantity manufactured, having turned out 46,417,148 pounds in 1900, or over 43 per cent of the total production of the country, and 42,331,822 pounds in 1901, or 40 per cent of the total. Its output in 1899 was 38,897,603 pounds, or nearly 47 per cent of the total. Kansas remains in second place, with a production in 1900 of 16,686,460 pounds, and slightly less in 1901. Ohio retains third place, having made a large increase from 1899 to 1900, and a still further increase in 1901, when the output was 16,443,973 pounds. Rhode Island (in the Connecticut district) and Indiana occupy fourth and fifth places. Their production increased to about 10,000,000 pounds in each of the fiscal years 1900 and 1901. The product of Missouri was more than doubled from 1899 to 1900,

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follows, together with the values of ingredients as reported in testimony before the Congressional committee considering an oleomargarine measure:

Quantities and kinds of ingredients used in the production of oleomargarine in the United States for the fiscal year ended June 30, 1899; also the percentage each ingredient bears to the whole quantity, its value per pound, and total value.

Material.	Quantity.	Percentage each ingredient bears to the whole.	Value per pound.	Total value.
	Pounds.		*Cents.*	*Dollars.*
Neutral lard	31,297,251	34.27	8	2,503,780.08
Oleo oil	24,491,769	26.82	9	2,144,917.69
Cotton-seed oil	4,357,514	4.77	6	522,025.08
Sesame oil	486,310	.53	10	4,863.10
Coloring matter	148,970	.16	20	29,296.00
Sugar	110,164	.12	4	4,406.50
Glycerin	8,963	.01	10	896.30
Stearin	5,890	.007	8	459.60
Glucose	2,550	.003	3	76.50
Milk	14,200,576	15.55	1	142,005.76
Salt	6,773,670	7.42	1	67,726.70
Butter oil	4,342,904	4.76	6	260,520.00
Butter	1,568,319	1.72	20	313,663.80
Cream	3,527,410	3.86	5	176,370.50
Total	91,322,260	100	....	6,171,007.61

when it was over 4,000,000 pounds, and fell off very slightly in 190 The Maryland district output (including the District of Columbi which is the important part in this connection), was more than doubl from 1899 to 1900, and it increased still further in 1901, to a little ov 2,500,000 pounds. New Jersey's production was much larger in 19 than in 1899, but in 1901 it was less than in 1899, being under 500,0 pounds. In 1900 a little more than 300,000 pounds of oleomargari were produced in the western part of Pennsylvania, and this w increased to over 2,000,000 pounds in 1901. Small amounts we made in Kentucky and Texas in 1900; the production increased fr twofold to fourfold in 1901.

Rhode Island is the principal source of oleomargarine which is wit drawn for export, having furnished 2,687,810 pounds for this purpo in the fiscal year 1901, or more than five-sevenths of the total amou withdrawn for export; most of the balance went from Illinois a Kansas (tables 3 and 4).

As would be expected, the number of establishments engaged in t manufacture and sale of oleomargarine considerably increased in t years 1900 and 1901. There were about twice as many manufacturer wholesalers, and retailers in these years as in 1898, the numbers bein in 1901, 32, 194, and 9,849, respectively. Although the production oleomargarine was greater in 1900 than in 1901, there were 5 mo manufacturers and 781 more retailers the latter year than the forme Manufacturers were located, in 1901, in ten States and the District Columbia.

Wholesalers were located in the District of Columbia and 33 State and Territories, Hawaii being a recent addition to the list. Retaile were located in the District of Columbia and every State and Terr tory except four, namely, California, Iowa, Nevada, and Utah; 2,8 retailers were in Illinois in 1901, and 1,699 in Ohio, Ohio's increa being remarkably rapid, having had 953 in 1899 and 513 in 1898. 1901 New Jersey had the third largest number of retailers, 630, havi increased from 259 in 1899—even a greater ratio of increase th Ohio's. Indiana was next, with 469 retailers, the number in 18 having been 292. Michigan increased from 152 in 1899 to 420 1901; Missouri from 222 to 404; West Virginia from 171 to 354; a Virginia from 109 to 236. The most notable decreases in numbers retailers from 1899 to 1901 were in Pennsylvania, where the numb fell from 721 to 376; Minnesota from 25 to 9; Nebraska from 90 to 6 New Hampshire from 13 to 3, and the District of Columbia from to 30 (table 4.)

The quantities of oleomargarine sold in different States are not re ularly reported, but such information was furnished for the year 189 in compliance with a special resolution of Congress, and was includ in an article on this subject issued by the Department of Agricultur

In that article it was shown that the amounts of oleomargarine disposed of in the different States are roughly indicated by the numbers of retail dealers. On this basis Illinois would still stand at the head of the list, but Pennsylvania, instead of being second, would be preceded by Ohio, New Jersey, and perhaps a few other States.

The revenue turned into the United States Treasury from the various taxes upon oleomargarine is, of course, proportionate to the total output. In 1901 the gross receipts were $2,518,101.44, of which about four-fifths, or a little over $2,000,000, came from the tax of 2 cents on each pound manufactured for domestic use. The remainder is from taxes upon manufacturers, wholesalers, and retailers (table 5).

Only 0.86 per cent of the internal revenue raised in 1900 came from oleomargarine, and only 0.82 per cent in 1901.

The export of oleomargarine is very light; 4,990,699 pounds went out in the fiscal year 1901, and only 4,256,067 in 1900, against 5,549,322 pounds in 1899. In 1901 nearly 70 per cent of the exports went from the port of New York and about 25 per cent from Baltimore; the remainder from several other ports (table 6).

There is no uniformity in monthly exports, the quantity depending upon many changeable conditions. In the year ended June 30, 1901, the months of largest export were February, 661,174 pounds; April, 607,087 pounds, and May, 546,362 pounds; the smallest export months being July, 274,188 pounds; September, 315,322 pounds; and October, 269,054 pounds. In the preceding year the largest monthly exports were in October, November, and June, and the smallest in December, February, and April (table 7).

The West Indies continue to furnish the chief outlet for exported oleomargarine. Those islands took more than half of the quantities sent out in the fiscal years 1900 and 1901. To the British West Indies alone there were shipped, in 1901, 1,333,358 pounds, which was a little less than in the preceding year. The amount sent to Cuba is rapidly increasing, being 722,075 pounds in 1901, compared to 157,706 pounds in 1899. Trade is apparently being pushed also in Haiti, where 168,898 pounds were shipped in 1901—more than six times the quantity shipped in 1899.

There is a decided falling off in the exports of oleomargarine to the French West Indies, the amount credited to that destination in 1901 being 140,300 pounds. In the same year 115,090 pounds were sent to the Danish West Indies. The quantity sent to Porto Rico in 1900 is given as 219,140 pounds, and none in 1901. To Germany there was exported in 1901, 1,234,942 pounds of oleomargarine, which was a large increase over the quantity in 1900, but less than that in 1899. To the United Kingdom only 148,505 pounds were sent in 1901, or less than half of the quantity of 1899. Newfoundland and Labrador, to which no oleomargarine was exported in 1898 or 1899, took 107,473 pounds in 1900 and none in 1901. Shipments to British Africa show a large increase, the amount forwarded to British South Africa in 1901 being 237,738 pounds. In 1900, 118,396 pounds were credited to Hawaii. The reports of exports show that increasing quantities of oleomargarine are being sent to numerous other countries, including several in the Tropics, China, and Japan. Besides the instances already mentioned, there have been marked decreases in the exports to Sweden and Norway and the British East Indies (table 8).

OLEO OIL.

The exports of oleo oil amounted to 146,739,681 pounds in 1900 and 161,651,413 pounds in 1901, showing a small increase over the preceding years. Considerably more than half of this went from the New York customs district. Baltimore was an important point of export. Small quantities were shipped also from Philadelphia, Boston, and a few other cities (table 9). The exports in the spring and summer months are generally a little larger than in the other seasons (table 10).

As in previous years, Netherlands furnished the principal outlet, taking 85,976,848 pounds in the fiscal year 1900, and practically the same amount, or 85,442,112 pounds, in 1901. The exports to Germany fell off about 2,000,000 pounds from 1899 to 1900, but from 1900 to 1901 increased nearly 7,000,000 pounds, to 33,482,368 pounds. Shipments to Denmark, Sweden and Norway, and the United Kingdom have shown large increases during the past three years, the quantities credited to those countries in 1901 being 11,734,927 pounds, 17,059,746 pounds, and 9,557,733 pounds, respectively. Exports of oleo oil to Newfoundland and Labrador have increased to over 1,000,000 pounds. Shipments to Austria-Hungary appear to have commenced only recently; they amounted to nearly 1,000,000 pounds in 1899, fell to less than 75,000 in 1900, and were 676,625 pounds in 1901. Shipments to Italy were practically nothing in 1900, but amounted to 617,947 in 1901, or almost eight times the quantity of 1899. It is interesting to note that 607,625 pounds were forwarded to British Australasia in 1900, and 68,580 pounds to British West Africa in 1901. Decreases are reported in the exports to some Canadian provinces (table 11).

FILLED CHEESE.

The production of filled cheese decreased in 1900 and 1901. The output in the latter year was 1,305,459 pounds, being the smallest recorded since the revenue law took effect in 1896. Practically all of the output was for export. The total revenue receipts from this article in 1901 were $14,652.64 (table 12.)

As in previous years, the production of filled cheese was discontinued during a large part of the warm season, and was largest in the winter months. The maximum monthly production in the two years ended June 30, 1901, was 319,846 pounds in April, 1900. Most of the filled cheese is exported; in fact, for a period of nineteen months ended November, 1899, none was withdrawn for domestic use, but in December of 1899 its withdrawal was resumed, and a little less than 50,000 pounds went into use in this country in that month and the five following. From June to December, 1900, there were no withdrawals for domestic use. They commenced again in January, 1901, and in five months amounted to a little over 50,000 pounds (table 13.)

In 1901, only 8 establishments were reported to be handling filled cheese. Five were manufactories in Illinois, 2 were retail establishments in the Maryland district, and 1 in the Louisiana district (tables 14 and 15).

The taxes collected on filled cheese in 1901 constituted less than half of one-hundredth of 1 per cent of the total internal revenue raised in the country.

TABLE 1.—*Production and distribution of oleomargarine and total revenue receipts therefrom, 1897 to 1901.*

Fiscal year ended June 30—	Quantity produced.	Withdrawn, tax paid.[a]	Withdrawn for export.[b]	Received, all sources.
	Pounds.	*Pounds.*	*Pounds.*	*Dollars.*
1897	45,531,293	42,508,469	3,148,407	1,034,129.60
1898	57,516,136	55,079,887	2,259,705	1,315,708.54
1899	83,139,901	79,701,108	3,095,738	1,956,618.56
1900	107,045,028	103,616,142	3,376,764	2,543,785.18
1901	104,943,856	101,432,717	3,507,193	2,518,101.44
Total for 5 years	398,176,214	382,338,323	15,387,807	9,368,343.32
Total since November 1, 1886[c]	859,589,360	821,401,615	36,326,294	21,003,988.05

[a] Two cents per pound.

[b] Without tax.

[c] Date when oleomargarine revenue law took effect.

TABLE 2.—*Monthly production and distribution of oleomargarine, July, 1899, to June, 1901.*

Year and month.	Quantity produced.	Withdrawn, tax paid.	Withdrawn for export.	Lost or destroyed.
1899.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
July	5,082,768	5,668,111	232,187	....
August	7,165,520	6,829,625	352,027	....
September	9,004,412	8,548,614	255,409	....
October	9,939,198	9,548,318	259,750	....
November	11,006,430	10,456,645	254,397	....
December	10,635,999	10,187,591	218,148	....
1900.				
January	10,495,705	10,080,212	242,247	....
February	9,853,370	9,750,396	308,419	....
March	10,841,485	10,706,494	349,257	4,019
April	8,331,454	8,279,597	197,338	2,900
May	7,398,463	7,214,623	357,179	7,500
June	6,570,224	6,345,916	350,406	56
Total	107,045,028	103,616,142	3,376,764	14,475

TABLE 2.—*Monthly production and distribution of oleomargarine, etc.*—Continued.

Year and month.	Quantity produced.	Withdrawn, tax paid.	Withdrawn for export.	Lost or destroyed.
1900.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
July	6,374,471	5,803,465	289,085	....
August	7,162,022	6,906,231	235,027	939
September	8,267,931	7,926,891	204,004	19,775
October	10,089,192	9,553,808	306,092	....
November	10,296,097	10,172,816	341,463	....
December	10,245,500	9,642,932	295,092	....
1901.				
January	10,172,916	10,072,223	322,069	....
February	8,991,326	8,581,747	267,861	100
March	9,166,371	8,935,583	269,641	750
April	9,506,852	9,291,179	322,746	32,899
May	8,190,183	8,333,653	343,623	....
June	6,480,965	6,211,889	310,470	44,555
Total	104,943,856	101,432,717	3,507,193	99,018

TABLE 3.—*Production and distribution of oleomargarine, by districts, 1899 to 1901.*

Internal revenue districts.	Produced.	Withdrawn, tax paid.	Withdrawn for export.	Lost or destroyed.	Remaining in factory June 30.
Year ended June 30, 1899.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Connecticut[a]	7,912,571	5,626,866	2,283,455	....	68,646
First Illinois	38,897,603	38,164,188	452,372	....	420,305
Sixth Indiana	7,086,909	7,038,393	2,500	....	89,668
Kansas[b]	13,459,994	13,188,496	331,208	....	92,543
Maryland[c]	1,056,432	1,054,337	....	....	2,145
Sixth Missouri	1,867,211	1,848,152	....	....	21,177
First New Jersey	439,472	410,052	20,500	....	8,920
Fifth New Jersey	101,185	104,400	3,000	....	....
Eleventh Ohio	9,991,823	9,948,075	....	....	62,029
Eighteenth Ohio	2,327,881	2,319,329	....	....	22,070
Total	83,141,081	79,702,288	3,096,035	....	787,503
Year ended June 30, 1900.					
Connecticut[a]	10,448,162	7,796,902	2,653,214	....	56,292
First Illinois	46,248,446	45,834,089	475,269	....	359,536
Thirteenth Illinois	168,732	165,623	....	....	4,109
Sixth Indiana	10,778,599	10,737,649	9,200	....	121,418
Kansas[b]	16,686,460	16,392,323	229,781	....	156,925
Fifth Kentucky	76,125	72,569	....	....	3,500
Maryland[c]	2,207,748	2,202,390	....	....	7,447
Sixth Missouri	4,107,696	4,118,273	....	....	3,220
First New Jersey	604,279	595,849	9,300	....	8,050
Fifth New Jersey	115,300	115,300	....	....	....
Eleventh Ohio	12,464,249	12,459,902	....	....	66,376

[a] Including the State of Rhode Island. No oleomargarine was manufactured in the State of Connecticut.

[b] Including the Indian Territory and the Territory of Oklahoma, but no oleomargarine was manufactured in either of these Territories.

[c] Includes Delaware, District of Columbia, and two counties of Virginia.

TABLE 3.—*Production and distribution of oleomargarine, etc.*—Continued.

Internal revenue districts.	Produced.	Withdrawn, tax paid.	Withdrawn for export.	Lost or destroyed.	Remaining in factory June 30.
Year ended June 30, 1900—Continued.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Eighteenth Ohio	2,734,214	2,739,898	....	....	16,386
Twenty-third Pennsylvania	301,158	281,485	....	....	14,564
Third Texas	103,890	103,890	....	....	....
Total	107,045,028	103,616,142	3,376,764	....	817,806
Year ended June 30, 1901.					
Connecticut [a]	10,786,496	8,085,968	2,687,810	....	49,235
First Illinois	42,273,266	41,571,302	668,259	....	350,902
Thirteenth Illinois	58,556	60,549	....	....	....
Sixth Indiana	9,143,286	9,184,200	13,980	....	66,659
Kansas [b]	16,365,738	16,246,090	135,444	....	141,808
Fifth Kentucky	165,133	160,630	....	....	8,003
Maryland [c]	2,670,218	2,676,404	....	....	....
Sixth Missouri	4,032,442	4,000,807	....	....	....
First New Jersey	144,275	151,425	900	....	....
Fifth New Jersey	308,591	307,791	800	....	....
First Ohio	1,098,503	1,073,354	....	....	25,139
Eleventh Ohio	12,739,370	12,775,313	....	....	30,433
Eighteenth Ohio	2,606,100	2,606,257	....	....	16,229
Twenty-third Pennsylvania	2,157,052	2,137,787	....	....	33,829
Third Texas	394,830	394,830	....	....	....
Total	104,943,856	101,432,717	3,507,193	....	722,237

[a] Including the State of Rhode Island. No oleomargarine was manufactured in the State of Connecticut.

[b] Including the Indian Territory and the Territory of Oklahoma, but no oleomargarine was manufactured in either of these Territories.

[c] Includes Delaware, District of Columbia, and two counties of Virginia.

TABLE 4.—*Number of manufacturers, wholesalers, and retailers of oleomargarine in each State and Territory, 1898 to 1901.*

[This table shows the number of establishments which paid taxes in the years named. The numbers vary slightly from the numbers actually in business, as taxes are sometimes paid before or after the year to which they apply.]

States and Territories.	For year ended June 30—											
	1898.			1899.			1900.			1901.		
	Manufacturers.	Wholesalers.	Retailers.	Manufacturers.	Wholesalers.	Retailers.	Manufacturers.	Wholesalers.	Retailers.	Manufacturers.	Wholesalers.	Retailers.
Alabama	......	2	11	......	2	19	......	3	20	......	3	39
Alaska	......	......	......	......	......	7	......	......	12	......	......	2
Arizona	......	1	3	......	1	5	......	2	11	......	1	5
Arkansas	......	1	29	......	1	33	......	1	57	......	1	46
California	......	......	......	......	......	......	......	......	......	......	......	......
Colorado	......	......	70	......	6	72	......	7	151	......	7	151
Connecticut	......	......	9	......	......	5	......	......	7	......	......	10
Delaware	......	......	7	......	......	21	......	......	57	......	2	50

TABLE 4.—*Number of manufacturers, wholesalers, and retailers, etc.*—**Continued.**

States and Territories.	For year ended June 30—											
	1898.			1899.			1900.			1901.		
	Manufacturers.	Wholesalers.	Retailers.	Manufacturers.	Wholesalers.	Retailers.	Manufacturers.	Wholesalers.	Retailers.	Manufacturers.	Wholesalers.	Retailers.
District of Columbia		2	50	1	2	58	2	3	43	2	3	30
Florida		4	75		5	78		6	102		7	109
Georgia		7	26		8	61		7	86		7	94
Hawaii											2	1
Idaho			1			3		1	4			6
Illinois	3	2	1,142	4	10	1,956	7	23	2,691	10	21	2,891
Indiana	2	4	231	3	5	292	4	4	419	4	7	469
Indian Territory			17			20			25			31
Iowa			2			3		1	3			
Kansas	2		107	2	1	183	2	1	201	3	4	193
Kentucky		2	157		1	214	1	3	299	2	2	316
Louisiana		4	116		4	118		5	176		5	284
Maine			4			13			24			9
Maryland	1	6	80		14	110		11	112		6	96
Massachusetts		1	28		12	76		9	100		3	82
Michigan		2	125		4	152		15	376		8	420
Minnesota		1	4		8	25		11	25		12	9
Mississippi			15			7		1	23		1	16
Missouri	1	2	124	1	1	222	1	2	332	1	4	404
Montana												1
Nebraska		2	60		1	90		4	62		3	63
Nevada												
New Hampshire		2	7		6	13		5	26		1	3
New Jersey	1	7	242	1	7	259	2	9	455	2	8	630
New Mexico			6			11		1	21			17
New York		3	27			14			11		2	11
North Carolina			5			7			26		1	37
North Dakota			9			18			8			7
Ohio	2	13	513	2	8	953	3	15	1,439	3	16	1,699
Oklahoma			3			10		1	12			19
Oregon						3			2			3
Pennsylvania		12	276		22	721	1	15	587	1	15	376
Rhode Island	3	5	320	3	5	318	3	4	316	3	5	315
South Carolina		2	19		2	21		2	51		3	54
South Dakota			3			4			8			5
Tennessee		1	37		3	76		2	94		5	85
Texas		4	19		12	144	1	15	139	1	16	132
Utah												
Vermont					1			1	3			1
Virginia		2	119		2	109		4	180		2	236
Washington			8		1	5			2			2
West Virginia		2	102		5	171		5	237		9	354
Wisconsin		6	15		4	17		4	20		2	18
Wyoming			5			5			13			18
Total	15	102	4,228	17	164	6,722	27	203	9,068	32	194	9,849
Number of States and Territories in which located	8	28	44	8	34	47	11	36	47	11	34	48

TABLE 5.—*Internal revenue receipts from oleomargarine, by districts, 1900 and 1901.*

Internal revenue districts.	Collections on oleomargarine at 2 cents per pound.	Special taxes of— Manufacturers.	Wholesale dealers.	Retail dealers.	Total.
Fiscal year ended June 30, 1900.					
Alabama			$880.00	$692.00	$1,572.00
Arkansas	$296.00		786.00	1,770.00	2,852.00
Colorado [a]			2,600.00	6,236.00	8,836.00
Connecticut [b]	159,651.56	$1,800.00	1,960.00	14,182.00	177,593.56
Florida			1,580.00	4,098.00	5,678.00
Georgia			2,640.00	2,802.00	5,442.00
First Illinois	923,378.40	3,400.00	6,840.00	90,812.00	1,024.430.40
Fifth Illinois			2,280.00	4,130.00	6,410.00
Eighth Illinois				4,708.00	4,708.00
Thirteenth Illinois	3,308.76	300.00	1,140.00	2,962.00	7,710.78
Sixth Indiana	214,083.62	1,450.00	1,796.00	11,060.00	228,389.62
Seventh Indiana				4,024.00	4,024.09
Third Iowa		600.00			600.00
Fourth Iowa				116.00	116.09
Kansas [c]	329,662.94	2,400.00	360.00	8,988.00	341,410.94
Second Kentucky				530.00	530.00
Fifth Kentucky	1,478.10	350.00	840.00	7,376.00	10,044.10
Sixth Kentucky				2,588.00	2,588.00
Seventh Kentucky				828.00	828.00
Eighth Kentucky				36.00	36.00
Louisiana [d]			5,160.00	8,516.00	13,676.00
Maryland [e]	44,074.42	1,000.00	7,060.00	6,554.00	58,688.42
Massachusetts			3,880.00	4,638.00	8,518.00
First Michigan	470.12		1,800.00	5,890.00	8,160.12
Fourth Michigan			4,480.00	6,922.00	11,402.00
Minnesota			4,200.00	904.00	5,104.00
First Missouri			840.00	9,836.00	10,676.00
Sixth Missouri	82,002.00	600.00		2,972.00	85,574.00
Montana [f]			1,140.00	156.00	1,296.00
Nebraska [g]			2,240.00	2,910.00	5,150.00
New Hampshire [h]			7,102.36	2,354.00	9,456.36
First New Jersey	11,920.98	600.00		2,640.00	15,160.98
Fifth New Jersey	2,326.56	250.00	3,420.00	13,832.00	19,828.56
New Mexico [i]			880.00	1,012.00	1,892.00
First New York				206.00	206.00
Second New York				48.00	48.00
Third New York				138.00	138.00
Twenty-first New York				48.00	48.00
Twenty-eighth New York				54.00	54.00
Fourth North Carolina				832.00	832.00
Fifth North Carolina				216.00	216.00
First Ohio			8,040.00	11,030.00	14,070.00
Tenth Ohio			1,600.00	7,472.00	9,072.00
Eleventh Ohio	249,286.66	1,000.00	680.00	18,020.00	268,986.66

[a] Colorado includes Wyoming.

[b] Connecticut includes Rhode Island.

[c] Kansas includes Indian Territory and Oklahoma.

[d] Louisiana includes Mississippi

[e] Maryland includes Delaware, District of Columbia, and two counties of Virginia.

[f] Montana includes Idaho and Utah.

[g] Nebraska includes North and South Dakota.

[h] New Hampshire includes Maine and Vermont.

[i] New Mexico includes Nevada.

TABLE 5.—*Internal revenue receipts from oleomargarine, etc.*—Continued.

Internal revenue districts.	Collections on oleomargarine at 2 cents per pound.	Special taxes of—			Total.
		Manufacturers.	Wholesale dealers.	Retail dealers.	
Fiscal year ended June 30, 1900—Cont'd.					
Eighteenth Ohio	$54,659.26	$600.00	$2,120.00	$19,808.00	$77,187.26
Oregon[a]				386.00	386.00
First Pennsylvania			2,880.00	5,328.00	8,208.00
Ninth Pennsylvania				320.00	320.00
Twelfth Pennsylvania			1,145.00	1,564.00	2,709.00
Twenty-third Pennsylvania	5,776.61	200.00	4,500.00	15,474.00	25,950.61
South Carolina			960.00	1,968.00	2,928.00
Second Tennessee	72.00			808.17	880.17
Fifth Tennessee			760.00	3,304.00	4,064.00
Third Texas	2,825.00	900.00	5,840.00	4,618.00	14,183.00
Fourth Texas			3,210.00	1,356.00	4,566.00
Second Virginia			1,060.00	4,492.00	5,552.00
Sixth Virginia				1,052.63	1,052.63
West Virginia			2,240.00	8,662.00	10,902.00
First Wisconsin			900.00	618.00	1,518.00
Second Wisconsin			1,080.00	246.00	1,326.00
Total	2,085,273.02	15,450.00	97,919.36	345,142.80	2,543,785.18
Fiscal year ended June 30, 1901.					
Alabama			1,040.00	1,190.00	2,230.00
Arkansas			480.00	1,870.55	2,350.55
Colorado[b]			2,500.00	5,178.00	7,678.00
Connecticut[c]	163,087.70	1,800.00	1,840.00	12,682.00	179,409.70
Florida			3,960.00	3,682.00	7,642.00
Georgia			3,360.00	3,076.00	6,436.00
Hawaii	96.00		880.00	48.00	1,024.00
First Illinois	831,004.13	6,200.00	5,240.00	110,066.50	952,510.63
Fifth Illinois			1,560.00	5,248.00	6,808.00
Eighth Illinois			560.00	5,644.00	6,204.00
Thirteenth Illinois	1,201.60	600.00	1,120.00	3,212.00	6,133.60
Sixth Indiana	184,417.02	1,875.00	3,080.00	13,634.00	203,006.02
Seventh Indiana				4,000.00	4,000.00
Kansas[d]	327,209.68	1,100.00	2,720.00	8,694.00	339,723.68
Second Kentucky				656.00	656.00
Fifth Kentucky	3,245.60	700.00	960.00	8,028.00	12,933.60
Sixth Kentucky				2,508.00	2,508.00
Seventh Kentucky				650.00	650.00
Eighth Kentucky				84.00	84.00
Louisiana[e]			4,160.00	8,332.00	12,492.00
Maryland[f]	53,661.10	1,200.00	4,560.00	6,270.00	65,691.10
Massachusetts			2,684.52	3,620.00	6,304.52
First Michigan			1,240.00	8,064.00	9,304.00
Fourth Michigan			1,420.00	7,176.00	8,596.00
Minnesota			3,760.00	276.00	4,036.00
First Missouri			1,380.00	13,734.00	15,114.00
Sixth Missouri	79,927.90			2,544.00	82,471.90

[a] Oregon includes Alaska and Washington.

[b] Colorado includes Wyoming.

[c] Connecticut includes Rhode Island.

[d] Kansas includes Indian Territory and Oklahoma.

[e] Louisiana includes Mississippi.

[f] Maryland includes Delaware, District of Columbia, and two counties of Virginia.

TABLE 5.—*Internal revenue receipts from oleomargarine, etc.*—Continued.

Internal revenue districts.	Collections on oleomargarine at 2 cents per pound.	Special taxes of— Manufacturers.	Wholesale dealers.	Retail dealers.	Total.
Fiscal year ended June 30, 1901—Cont'd.					
Montana [a]			$720.00	$246.00	$966.00
Nebraska [b]			1,440.00	3,038.00	4,478.00
New Hampshire [c]			480.00	434.00	914.00
First New Jersey	$3,012.50			4,356.00	7,368.50
Fifth New Jersey	6,167.62	$600.00	3,280.00	20,992.00	31,039.62
New Mexico [d]			480.00	1,024.20	1,504.20
First New York				120.00	120.00
Second New York				114.00	114.00
Third New York				388.00	388.00
Twenty-eighth New York			640.00	48.00	688.00
Fourth North Carolina				834.00	834.00
Fifth North Carolina				280.00	280.00
First Ohio	21,772.74	350.00	2,760.00	11,208.00	36,090.74
Tenth Ohio		600.00	2,240.00	9,312.00	12,152.00
Eleventh Ohio	254,787.40	600.00		22,252.00	277,639.40
Eighteenth Ohio	52,179.08		1,440.00	21,792.00	75,411.08
Oregon [e]			60.00	270.00	330.00
First Pennsylvania			2,800.00	1,958.00	4,758.00
Ninth Pennsylvania				126.00	126.00
Twelfth Pennsylvania				604.00	604.00
Twenty-third Pennsylvania	42,846.60	600.00	2,880.00	14,324.00	60,650.60
South Carolina			1,800.00	2,202.00	4,002.00
Second Tennessee				260.00	260.00
Fifth Tennessee			2,240.00	1,772.00	4,012.00
Third Texas	8,280.00		4,780.00	3,730.00	16,790.00
Fourth Texas			1,680.00	1,060.00	2,740.00
Second Virginia			1,320.00	7,310.00	8,630.00
Sixth Virginia				1,636.00	1,636.00
West Virginia			3,200.00	12,740.00	15,940.00
First Wisconsin				488.00	488.00
Second Wisconsin			960.00	160.00	1,120.00
Total	2,032,926.67	16,225.00	83,704.52	385,245.25	2,518,101.44

[a] Montana includes Idaho and Utah.

[b] Nebraska includes North and South Dakota.

[c] New Hampshire includes Maine and Vermont.

[d] New Mexico includes Nevada.

[e] Oregon includes Alaska and Washington.

TABLE 6.—*Exports of oleomargarine, by customs districts, 1899 to 1901.*

Customs districts.	Fiscal year ended June 30— 1899.	1900.	1901.
	Pounds.	*Pounds.*	*Pounds.*
Baltimore, Md	1,512,462	475,911	1,299,387
New Bedford, Mass			1,396
Boston and Charlestown, Mass	125,247	158,885	1,820
Newport News, Va	27,983		
Charleston, S. C		1,000	

TABLE 6.—*Exports of oleomargarine, by customs districts, 1899 to 1901*—Continued.

Customs districts.	Fiscal year ended June 30—		
	1899.	1900.	1901.
	Pounds.	*Pounds.*	*Pounds.*
New York, N. Y	3,001,327	3,164,692	3,433,986
Philadelphia, Pa	603,081	64,671	39,800
Portland, Me	1,070	....	....
Savannah, Ga	100	....	....
St. Johns, Fla	....	....	800
Key West, Fla	1,595	240	11,031
Mobile, Ala	9,135	12,101	30,257
New Orleans, La	21,313	17,849	36,162
Tampa, Fla	120	....	....
Saluria, Tex	6,714	8,564	3,982
Puget Sound, Wash	32,361	61,770	14,350
San Diego, Cal	....	32,629	22,545
San Francisco, Cal	177,634	68,980	66,373
Willamette, Oreg	540	....	....
Detroit, Mich	28,640	184,370	26,320
Huron, Mich	....	1,339	2,000
North and South Dakota	....	....	490
Vermont, Vt	3,066	....	....
Total	5,549,322	4,256,067	4,990,699

TABLE 7.—*Monthly exports of oleomargarine, quantities and values, 1900 and 1901.*

Month.	Fiscal year ended June 30—			
	1900.		1901.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
July	380,809	36,526	274,188	27,569
August	426,589	40,769	437,979	40,398
September	323,314	30,673	315,322	31,795
October	447,857	40,871	269,054	27,916
November	445,717	39,974	327,898	33,598
December	249,846	27,232	417,521	43,664
January	298,341	27,722	392,143	35,999
February	242,895	26,751	661,174	60,611
March	411,811	42,757	363,213	35,190
April	232,214	22,893	607,087	56,311
May	332,441	32,267	546,362	51,664
June	464,233	48,109	379,511	39,998
Total	4,256,067	416,544	[a] 4,990,699	[a] 484,581

[a] The totals reported at the end of the year do not exactly agree with the sum of the monthly figures shown above, but the latter are given as published in monthly reports.

TABLE 8.—*Exports of oleomargarine, quantities and values, by countries, 1899 to 1901.*

Country of import.	Quantities.			Values.		
	1899.	1900.	1901.	1899.	1900.	1901.
	Pounds.	*Pounds.*	*Pounds.*	*Dollars.*	*Dollars.*	*Dollars.*
Azores, and Madeira Islands	....	....	3,326	....	....	479
Belgium	44,680	58,265	77,770	4,678	6,073	7,892
Denmark	27,940	....	....	2,500	....	....
Germany	1,965,559	448,769	1,234,942	156,770	87,049	97,522
Italy	29,962	....	....	2,900	....	....
Portugal	4,600	2,000	3,850	514	200	414
Spain	....	....	1,500	....	....	150
Sweden and Norway	40,896	17,990	16,710	2,863	1,400	1,499
United Kingdom	307,798	364,712	148,505	24,636	84,074	14,710
Bermuda	32,243	32,015	39,965	3,521	3,786	5,038
British Honduras	1,450	7,880	19,185	146	1,097	2,108
Dominion of Canada:						
Nova Scotia, New Brunswick, etc.	....	....	2,000	....	....	260
Quebec, Ontario, etc	....	3,066	26,410	....	245	2,650
British Columbia	18,450	....	400	2,200	....	36
Newfoundland and Labrador	....	107,473	....	....	7,200	....
Central American States:						
Costa Rica	16,545	73,531	119,217	1,759	7,461	11,519
Honduras	1,858	260	....	204	31	....
Nicaragua	3,022	3,035	2,200	405	397	257
Mexico	7,514	9,194	4,057	731	993	548
Miquelon, Langley, etc	7,320	2,800	1,820	594	310	195
West Indies:						
British	1,527,342	1,466,638	1,333,358	148,097	146,959	134,498
Danish	124,450	116,890	115,090	10,135	8,530	9,523
Dutch	20,726	41,605	49,234	1,897	3,280	4,084
French	226,810	157,200	140,300	21,746	13,501	14,152
Haiti	26,663	50,088	168,898	2,706	4,989	17,972
Santo Domingo	1,120	9,784	6,400	112	906	580
Cuba	157,706	516,463	722,075	19,658	60,693	81,909
Porto Rico	204,891	219,140	....	22,903	22,776	....
Argentina	400	....	....	48	....	....
Brazil	....	100	....	....	18	....
Colombia	123,224	113,777	122,424	11,225	9,675	11,125
Ecuador	....	837	1,740	....	106	238
Guianas:						
British	167,070	133,236	182,800	18,877	14,638	20,778
Dutch	54,600	59,700	58,536	4,959	5,486	5,032
Peru	....	....	120	....	....	12
Uruguay	200	....	....	25	....	....
Venezuela	42	....	....	4	....	....
Russia, Asiatic	....	....	14,350	....	....	1,494
China	11,860	7,626	28,841	1,630	670	3,043
East Indies: British	44,600	2,300	5,500	5,795	328	605
Hongkong	136	1,560	....	14	194	....
Japan	19,185	41,309	62,377	1,970	4,412	5,820
Hawaiian Islands	151,460	118,396	....	15,471	11,800	....
British Africa	150,900	66,908	....	15,225	7,102	....
British South Africa	....	....	237,738	....	....	23,683
British East Africa	....	....	29,110	....	....	3,840
Canary Islands	....	....	336	....	....	32
Portuguese Africa	....	....	1,070	....	....	105
All other Africa	100	50	....	10	8	....
Other countries	26,009	1,470	8,545	2,775	157	699
Total	5,549,322	4,256,067	4,990,699	509,703	416,544	484,501
Average per pound ....cents	....	....	....	9.2	9.8	9.7

TABLE 9.—*Exports of oleo oil, by customs districts, 1899 to 1901.*

Customs districts.	1899.	1900.	1901.
	Pounds.	*Pounds.*	*Pounds.*
Baltimore, Md	38,736,469	43,227,556	34,237,714
Bangor, Me	1,226	354,243	77,098
Boston and Charlestown, Mass	4,459,139	5,897,560	7,368,709
New York, N. Y	91,623,920	87,167,125	111,558,553
Norfolk and Portsmouth, Va	....	348,997	....
Newport News, Va	....	....	81,819
Philadelphia, Pa	7,482,808	9,550,617	6,482,325
Portland and Falmouth, Me	....	80,840	132,151
New Orleans, La	....	....	300
Saluria, Tex	....	....	19,494
Detroit, Mich	47,850	81,900	870,858
Huron, Mich	39,080	24,000	816,397
North and South Dakota	....	6,049	....
Vermont, Vt	....	794	11,000
Total	142,390,492	146,739,681	161,651,413

TABLE 10.—*Monthly exports of oleo oil, quantities and values, 1899 to 1901.*

Month.	1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
July	14,746,933	848,827	12,692,477	872,205	13,342,792	985,403
August	11,600,148	667,517	13,438,025	910,130	17,076,266	1,256,983
September	10,668,719	635,072	9,681,527	700,127	11,649,497	842,043
October	11,676,227	731,878	8,609,274	656,009	12,703,835	931,844
November	8,287,594	512,055	9,167,051	672,767	13,264,917	960,790
December	10,762,801	662,056	11,593,796	857,502	10,703,607	768,479
January	9,012,969	574,707	9,875,713	782,610	13,262,121	907,244
February	9,399,349	679,277	12,583,941	923,138	8,714,704	632,681
March	13,172,038	942,918	13,495,147	961,799	12,481,946	912,137
April	12,490,677	856,441	11,102,549	778,246	13,360,520	1,029,639
May	13,083,108	908,272	13,271,051	926,925	17,594,957	1,326,027
June	17,439,929	1,164,639	21,229,127	1,462,398	17,496,251	1,298,123
Total	142,390,492	9,183,659	146,739,681	10,503,856	161,651,413	11,846,373

TABLE 11.—*Exports of oleo oil, quantities and values, by countries, 1899 to 1901.*

Country of import.	Quantities.			Values.		
	1899.	1900.	1901.	1899.	1900.	1901.
	Pounds.	*Pounds.*	*Pounds.*	*Dollars.*	*Dollars.*	*Dollars.*
Austria-Hungary	946,500	73,634	676,625	55,935	4,786	42,350
Belgium	2,065,814	2,892,778	1,800,757	136,054	212,457	135,558
Denmark	3,657,257	8,628,948	11,734,927	240,511	675,053	909,984
France	142,872	167,047	22,500	9,335	10,800	1,800
Germany	28,647,410	26,780,986	33,482,368	1,923,259	2,104,818	2,549,853
Italy	82,252	250	617,947	4,740	15	42,721
Netherlands	86,452,770	85,976,848	85,442,112	5,514,523	5,912,334	6,131,071
Turkey, European			44,788			2,875
Sweden and Norway	12,054,375	13,500,332	17,059,746	788,862	960,047	1,224,334
United Kingdom	7,393,110	7,285,764	9,557,733	452,239	512,745	717,056
Dominion of Canada:						
Nova Scotia, New Brunswick, etc	155,265		46,766	8,399		3,506
Quebec, Ontario, etc	40,780	27,494	19,130	2,252	1,906	1,321
Newfoundland and Labrador	697,709	709,817	1,043,005	44,767	54,353	75,928
Mexico			19,494			1,485
West Indies:						
Haiti			5,600			418
Cuba	2,000		8,255	109		494
Brazil		4,652			391	
Guiana, British		3,000			270	
British West Africa			68,580			5,487
British Australasia		607,625			45,572	
Other countries	52,378	100,506	1,080	2,674	8,309	102
Total	142,390,492	146,739,681	161,651,413	9,183,659	10,503,856	11,846,373
Average per pound.....cents				6.4	7.2	7.3

TABLE 12.—*Production and distribution of filled cheese and total revenue receipts therefrom, 1897 to 1901.*

Fiscal year ended June 30—	Quantity produced.	Quantity withdrawn, tax paid.		Received all sources.
		For domestic use.	For export.	
	Pounds.	*Pounds.*	*Pounds.*	*Dollars.*
1897 (from Sept. 4, 1896)	1,663,067	1,475,954	187,113	18,992.38
1898	1,402,861	1,383,993	18,868	16,518.55
1899	1,688,650		1,688,650	18,098.42
1900	1,574,979	48,492	1,526,487	17,064.48
1901	1,305,459	52,191	1,253,268	14,652.64
Total	7,635,016	2,960,630	4,674,386	85,326.47

TABLE 13.—*Monthly production and distribution of filled cheese, 1898 to 1901.*

Year and month.	Quantity produced.	Quantity withdrawn, tax paid.	
		For domestic use.	For export.
1898.	*Pounds.*	*Pounds.*	*Pounds.*
July	....	....	....
August	....	....	....
September	....	....	....
October	....	....	....
November	....	....	....
December	71,856	....	71,856
1899.			
January	223,830	....	223,830
February	231,635	....	231,635
March	317,112	....	317,112
April	234,025	....	234,025
May	275,127	....	275,127
June	335,065	....	335,065
July	....	....	....
August	....	....	....
September	....	....	....
October	84,375	....	84,375
November	113,346	....	113,346
December	168,742	26,019	142,723
1900.			
January	218,508	3,613	214,895
February	221,673	....	221,673
March	235,818	3,638	232,180
April	319,846	....	319,846
May	212,671	15,222	197,449
June	....	....	....
July	....	....	....
August	....	....	....
September	20,913	....	20,913
October	95,133	....	95,133
November	229,269	....	229,269
December	175,663	....	175,663
1901.			
January	257,509	3,967	253,542
February	250,549	4,163	246,386
March	126,069	3,423	122,646
April	112,906	3,190	109,716
May	37,448	37,448	....
June	....	....	....
Total	4,569,088	100,683	4,468,405
Total since September, 1896	7,635,016	2,960,630	4,674,386

TABLE 14.—*Number of manufacturers, wholesalers, and retailers of filled cheese, by States, 1899 to 1901.*

State or Territory.	For year ended June 30—								
	1899.			1900.			1901.		
	Manufacturers.	Wholesalers.	Retailers.	Manufacturers.	Wholesalers.	Retailers.	Manufacturers.	Wholesalers.	Retailers.
Illinois	5	....	....	6	....	....	5	....	....
Louisiana	....	....	....	....	....	....	....	....	1
Maryland	....	....	....	....	....	2	....	....	2
Total	5	....	....	6	....	2	5	....	3
Number of States and Territories in which located	1	....	1	1	....	1	1	....	2

TABLE 15.—*Internal revenue receipts from filled cheese, by districts, 1899 to 1901.*

Internal revenue districts.	Collections on filled cheese at 1 cent per pound.	Special taxes of— Manufacturers.	Special taxes of— Wholesale dealers.	Special taxes of— Retail dealers.	Total.
Year ended June 30, 1899.					
First Illinois	$16,886.41	$1,200.01	....	....	$18,086.42
Maryland[a]	....	....	....	$12.00	12.00
Total	16,886.41	1,200.01	....	12.00	18,098.42
Year ended June 30, 1900.					
First Illinois	15,750.47	1,300.01	....	14.00	17,050.48
Maryland[a]	....	....	....	....	14.00
Total	15,750.47	1,300.01	....	14.00	17,064.48
Year ended June 30, 1901.					
First Illinois	13,055.97	1,566.67	....	....	14,622.64
Louisiana	....	....	....	6.00	6.00
Maryland[a]	....	....	....	24.00	24.00
Total	13,055.97	1,566.67	....	30.00	14,652.64

[a] Including the State of Delaware, District of Columbia, and two counties of Virginia.

THE BUSINESS OF BREEDING PUREBRED STOCK.

By John A. Craig, B. S. A.,
Late Professor of Animal Husbandry in Iowa Agricultural College.

With the improvement which has taken place in the market for all kinds of farm live stock and their products, there has grown a corresponding interest in breeding animals. It is desirable to produce purebreds, not only because of the enlarged profit from their sale, but also for the reason that their powers of profitable production are greater and these powers may be reproduced with greater certainty than with grades. There are many who are anxious to engage in this work, but lack of information in reference to the breeds and methods of registration present difficulties that can not be removed by study, as there are few sources along this line. It is the object of this article to arrange such information as we have in this direction, and present the details of the business of producing purebred stock in as comprehensive and concise a form as possible. To do this, it will be necessary to submit some of the first principles connected with the formation of breeds and their perpetuation, and then discuss the utility of pedigrees and the methods of recording, together with the other features associated with the sale and disposal of purebred stock.

QUALIFICATIONS OF A BREEDER.

The first question that naturally arises in the mind of one considering the advisability of taking up this work is, to put it briefly, Have I the qualifications necessary to make a success of this line of effort? The answer to this may be found in a summary of the qualifications which seem to be most essential for a breeder to possess. It is of paramount importance that the breeder should have a decided taste for the care of and association with domestic animals. This essential feature of his nature is one which he can not acquire by training or study, and if lacking it is sure to make his work develop into drudgery. Having this sympathetic feeling for animals, it is further necessary that there should be in the mind of the breeder a clear conception of the merits and demerits of the different classes of stock. The leading lesson standing out from the lives of all past breeders of note is this: Every one of them has been a keen and accurate judge of the various classes of live stock. This means that their merits and demerits were plainly evident, owing to the close powers of observation which these men possess, and, further than this, they were possessed of judgment of unusual soundness, which enabled them to see the qualities desired and follow the best course of developing them. They have all been men who kept in close touch with the progress of other breeders and were ever ready to take advantage of the experience of coworkers, but at the same time so strong in their judgment as readily to adhere to a given ideal in the establishment of their herd.

WHAT IS A BREED?

Without the qualifications enumerated above, it would be a mistake for anyone to undertake the raising of purebred domesticated animals. In undertaking this work it is necessary to begin at the foundation with a clear conception of what makes a breed and of the attention necessary to develop and maintain it. A breed is a group of animals separated from others of the same species by distinctive characteristics which are so fixed by heredity that they are almost invariably transmitted. The characteristics shown must be so marked as to separate at once the animals claiming to be of different breeds, and, furthermore, these qualities must be so attached or bred into the animal that their prepotency asserts itself when crossed with other animals of mixed origin. A representative of any breed when crossed on a grade or common animal should not fail to transmit to the progeny a large proportion of those qualities which it is known to possess as a breed.

If we attempt to separate the breeds of live stock by any general qualifications, we find much difficulty because of the vast variation that exists, not only between the breeds, but also within them. These variations are most generally differences in color and form. Nearly all breeds have peculiar markings, which enables one to separate them from the others, and these are very persistent in being transmitted. To the common observer these differences in color and markings do not have the importance that they hold in the mind of the breeder. On first consideration it seems a small matter that the Hereford should have a white face, that the Aberdeen Angus should be black, or that the Poland China should be black with six white points; but when the reason for this is thought out it will be found to be of vast importance in the work of producing purebred stock. Not only is it desirable to have uniformity in the breed in color and markings, but, what is of more importance, these markings are of value because they are the very best evidences we can obtain of purity of breeding. Any admixture of foreign blood in a breed will invariably assert itself by some peculiar marking. To illustrate this further, it may be stated that at a very early time a Galloway cross was introduced into the Shorthorn; this resulted in blackening the nose of this breed of cattle, and for a long time Shorthorns with black noses were shunned because this rather insignificant feature indicated that there were traces of this Galloway blood in the pedigree of the animal showing it. Rigid adherence to color and markings has made these decided characteristics of the different breeds, and they must have prominence, as they are more or less of a guide to the breeder in giving direction to his work.

Color and marking, however, are not always a distinguishing feature, as there are a number of breeds that possess one color in common. For example, the Devon and the Shorthorn and Sussex are usually all red in color, yet they may be easily separated on account of the type or difference in form. In form we have one of the most distinguishing features pertaining to the breeds. Distinguishing forms are observable in the breeds of horses, being most marked between those noted for speed and for draft; among cattle the dairy breeds are distinct in type from those that are known as beef breeds; and in sheep those that are noted for the production of wool are distinct from the others that are valuable on account of their mutton-producing qualities; and so it is in the instance of a pig, the lard hog differing markedly in type from that which is suited for bacon. But not only are there differences in form due to differences in function and market demands, but there are also features which differ because the breeders have cherished different ideas. In the Clydesdale horse we see the Scotchman's idea of what a draft horse should be. His demands are exacting in regard to action and set of limbs, and consequently this breed illustrates these ideas most prominently. The Frenchman embodies his ideas in the Percheron horse, and, standing out clearly among these, we note the valuable characteristic of quality with durability. In the Shire horse the Englishman personifies his conceptions of what a draft horse should be, and, as represented in this breed, we note that he places the requirement of weight beyond all other considerations. These ideas of the different breeders have to be considered, and they are usually evident to the student who will candidly consider the characteristic form of the breeds and seek out their origin.

From the standpoint of utility there are more important features attached to each breed than those which we have mentioned in regard to color and form. These are more important qualities because they relate to the adaptability of the different breeds to the conditions of soil, climate, management, and markets. This adaptability is understood only by an intimate knowledge of the origin of the different breeds, the peculiar conditions under which they were formed, and the object held in view by the leading breeders. To illustrate clearly this feature of adaptability, perhaps the best instance is shown by the breeds of sheep. As sheep are animals that have always been more or less exposed to the influences of climate, owing to the management which must govern them, it is not surprising that the marked differences between the breeds is largely due to soil and management associated with them in their origin. For instance, there is one breed (the Romney Marsh) which does best on the low fens, or marshy lands, under conditions that would soon lead to the degeneration of any other breed. The home of this breed has been reclaimed from the sea and it is actually below its level, and yet this territory carries more sheep per acre than any other in Great Britain. On the other hand, the Highland sheep do best in mountainous districts where they have to travel much for food and are compelled to stand exposure to inclement weather. While the one breed thrives best on soil below the level of the sea, another has its highest development under the conditions attendant on a life 3,000 or 4,000 feet above this line. The former is of a large, heavy frame and form and rather sluggish in type, while the other is exceedingly vigorous and more nimble footed. The Leicesters and Cheviots may be mentioned in the same connection. The former can not stand exposure, as they are of tender constitution, having been bred for years under conditions which protect them from climatic influences; the Cheviots illustrate the other extreme, owing to the conditions of their mountainous life, and they have been known to be buried for hours under snow and yet come out hearty and uninjured when the conditions permitted.

Darwin observed that in a district stocked with Lincolns, which are one of the heaviest breeds of mutton sheep, and with Dorsets, which are much lighter, the breeds would separate as soon as they were turned out to pasture, the Lincolns seeking the lower lands of richer soils and more luxuriant pasture and the Dorsets winding their way to the lighter and drier uplands. In reference to the influence and management in making breeds, the two dairy breeds of cattle, the Jersey and Ayrshire, afford an excellent illustration. The conditions surrounding the Jersey on her native island have been influential features in determining her worth as a cow for intensive farming and for the production of butter. The kind treatment she receives, more particularly the method of tethering in pastures, have all produced a disposition very desirable in a herd of dairy cows. On the other hand, conditions surrounding the Ayrshire in her native home are more vigorous in treatment and management and she has to obtain her subsistence under more severe conditions and produce milk without as much forced feeding. As a result, she is a cow with unlimited constitution and completely adapted for pasturing on rough lands, as she is a good forager. These two breeds also illustrate the influences of the market demands in molding the characteristics of a breed. The ability of a breed to meet certain market demands and conditions is a very important matter to consider, for the profit of it depends mostly on this. The Jersey was bred, fed, and managed to produce butter. The people of the Isle of Jersey depended largely on the British butter market as a means of revenue, and as a consequence the object they held in view in breeding their cattle was to develop a breed of butter producers, both in reference to quantity and quality, and in this they have been eminently successful. On the other hand, the Ayrshire has been subject to different lines of treatment. Cheese factories predominate in their home region, and, under the conditions existing there, the cattle desirable for developing the cheese industry were constantly in the view of the Ayrshire breeders. These breeders inferred that the yielding of a large quantity of milk, made economically, was the most desirable characteristic of the cheese cow, and their breed reflects this inference. From the instances which have been presented it will likely be clear that the most important difference between the breeds is their adaptability for different conditions. The characteristics which they have are those which make them most suitable for certain soils, climates, management, and markets. These characteristics emphasize the importance, at the beginning of the work of breeding any class of purebred stock, that the breeder should thoroughly understand his own conditions and then select the breed which meets these in the most satisfactory manner.

SOURCE OF THE BREEDS.

After taking this preliminary view of the breeds let us inquire into their general conformation and trace their development, thereby gaining a knowledge of their origin, the herdbooks, and the subject of pedigrees. In general, there is reason to believe that nearly all our breeds of domesticated animals have originated from the wild species, and have been brought to their present high standard of development largely through careful selection and the force of environment. It is to be remembered that for centuries, agencies have been at work evolving material for our breeds. It is stated on reliable authority that since the year 2100 B. C. animals of the cattle species have been under domestication, yet it is impossible to say at what time the several breeds of cattle had their origin. Their development has, of necessity, been so gradual that the time they actually originated has been overlooked. They have been known as a breed only since their fixed characteristics have been evolved.

Understanding the source of the breeds to be an unimproved type, it is clear that the breeder must devote unceasing attention to his stock to keep it from going backward. It is the constant tendency of all improved stock to revert to the original type unless the environment which surrounds them and the mating which directs their future course are more favorable to the preservation of the improved type. Thus in beginning of pure breeding of stock the breeder must equip himself with the facilities for caring for them in the very best way, in order that they may continue to improve rather than retrograde under his care.

FORMATION OF BREEDS.

The formation of breeds and their after improvement have for their basis the degree of variation which exists in all animal life. It is helpful to remember that no two living things are exactly alike; life and variation are inseparable. You may compare the leaves of the tree and all will be found different. Even those on the same twig will greatly differ, though the conditions surrounding their growth have been almost identical. So in animal life, every animal differs from every other animal in its capabilities and qualities. Nature is said never to repeat herself, and man has not proved able, in the breeding of domesticated animals, so thoroughly to control conditions as to produce exact duplicates. This is an important point to have in mind, for it is through this universal variation, consisting perhaps of slight differences at first and only noticeable to the trained eye, that animals are made to grow through careful selections into striking contrasts which may be seen by anyone. This prevalent variation places in the hands of the breeder unusual power and selection. Understanding what variations are desirable, and having the ability to see them, the breeder strengthens and develops them by proper mating and favorable surroundings. Constant selection for certain purposes have given us the most of our breeds of live stock, and it is only by painstaking selection that these types and qualities may be maintained.

The most important variation in the view of the breeder is that which occurs in the functions of the different animals—the development of dairy cattle, the progress of standard-bred horses, and the many other lines of breeding which illustrate the development of function; all show wonderful possibilities in this direction. The cow of early days gave no more milk than would satisfy her calf, but man, by cultivating that function through breeding and development, has greatly enlarged upon it for his own use, until the sole purpose of the dairy cow is to devote every day of the year to the production of milk. In 1852 there was only one horse in America known to be able to trot in 2:30; the last issue of the Trotting Year Book (1901) contains nearly 20,000 of them that can pace or trot in this time. This fact is very illustrative of the development of a trait due to constant selection and cultivation.

Not only will selection accomplish results of this nature, but the mere change in conditions may fix variations. The most marked instance of this may be shown by the comparison of the status of the dog in the Orient and in this country. In the former country, where the dog is considered edible and is treated with this object in view, it becomes very sluggish and, in brief, develops all the characteristics of a hog. In this country, treated as the companion of man, the dog possesses intelligence and activity and is quite different from the hog in many respects. On the other hand, under suitable environment, hogs have developed the traits common to our dog. Instances have been known where they have been trained to hunt and show extraordinary sagacity in the pursuit of game. Their uncommonly keen scent has been utilized for this service and they have even been taught to "point" as efficiently as a pointer dog. Domestication of itself tends to produce variations, some of which are desirable and should be perpetuated, and others which should not be reproduced. To illustrate how these influences may develop desirable qualities, reference may be made to the wild sow, which produced only 6 or 7 pigs at a birth, while some of our domesticated sows, under the most favorable environment, have been known to produce 20 in a litter. Selection for such a characteristic undoubtedly fixes prolificness, and the same is true of any other characteristic. For the breeder to make progress, it is only necessary to observe some variation that has utility and then to fix this by intelligent breeding.

A change in the conditions of the market may also hasten the development of variations along certain lines. The development in the sheep markets within recent years, a feature which formerly existed in the cattle market, will illustrate this point clearly. At an early time in England cattle were of value chiefly for their labor and their hides. It was thought that the cattle industry would be ruined if hides were admitted from other countries. However, when this policy was adopted, it became evident that cattle were also useful for their meat, and it was not long before it was realized that in the production of meat cattle would yield a much greater profit than that which had been obtained from their hides and their labor. This hastened the development of our beef breeds of cattle. Similarly, at an early time sheep were solely reared for their wool. The decline in the price of this hastened the development of their mutton qualities until at this time they may be said to be the predominating influence in modern sheep husbandry. Not only are there numerous variations possible, giving the breeder the opportunity to exert his skill, but there are also sports in breeding, which have assisted the breeder in the formation of breeds. Sports are marked deviations from the normal, and they may easily be made the foundation of a breed by the careful selection and mating of those possessed of such deviations. Black lambs occurring in a flock is an instance of this nature, and we know that the selection toward this color has founded several flocks, both in this country and in Australia, which produce a larger percentage of black lambs than of white ones. The polled feature in cattle bears out this proposition, for there are no traces of this characteristic among the original source of our breeds of cattle. A later-day production of Polled Durham shows just how this may be made a breed feature. The polled characteristic in this instance originated from a sport, and by constant selection with this feature in view we now have a strain of Shorthorn cattle called the Polled Durham. Those that are known as double standard are not only purebred Shorthorns, but they also have this additional feature of being hornless.

PERPETUATION OF THE BREEDS.

Inferring that some breeders have noticed variations such as have been indicated, and that they desire to reproduce and fix these so as to make a breed, it is necessary that they undertake the practical details of getting together the foundation stock and keeping records of their produce. All the animals having this variation that are desired are brought together for a foundation, and with these as a basis they select from their progeny all those animals which best meet the requirements and furnish the material for a breed. The next step is to assemble all the breeders of such stock and organize a society.

The first procedure in the organization of a society is to draw up rules of entry, giving all information needed as to the breeding that the animals must have before they may be recorded. In addition to this, a standard of excellence is adopted enumerating the points which it is desired to perpetuate. At first foundation stock is accepted and a day is set limiting the time during which animals will be received as foundation stock. After this time has expired the animals that are accepted then for registration have to trace to the foundation stock already recorded.

As the pedigrees of the animals are received by the secretary of the society he assigns to each one a number in the order which it is received, and these numbers are known as the registration numbers. They are entered in a book which is issued usually each year, and such books are known as the stud-book, herd-book, and flock-books of the breeds. It may be stated that the numbers for animals registered in American herd-books are usually given without brackets. Those of the Canadian or European records are either in brackets or marked off by dashes. Following the number, the initial letter of the record in which the animal is registered is generally given. In this way it is easy to ascertain in what book the breeding of the animal will be found.

FORMATION OF FAMILIES.

After the breed has been established for some time it begins to divide into families, and it is by the knowledge of these and their performances and qualities that the intelligent breeder gains a deep insight into the merits of the breeds. All the breeds are divided into families mostly tracing their origin to the herd of some noted breeder, and likely, also, to a noted animal. To illustrate this, the leading families of the Shorthorns may be cited. When this breed was establishing its reputation, two breeders with very different ideals began their work. Thomas Bates desired to develop the milking qualities of the Shorthorn in his herd, and, in conformity with this, he paid much attention to that feature. As a result, he developed the Bates family of Shorthorns and made them especially noted for their milking qualities at that time, and this reputation is still considered in existence to-day. With this as a leading feature in the development of his herd, he also sought to produce a type noted for style and finish. On the other hand, the Booths considered beef of the most importance, and developed their herd more strongly in that direction. They did not hold the deep milking qualities or the features of finish and style in such high respect as Bates had done, and their cattle reflected this ideal. Following the work of both of these breeders came that of the Cruikshanks, who sought and developed a herd possessed of abundance of constitution, thick flesh, and early maturing qualities. The Shorthorns that they bred became known as Cruikshanks, or Scotch Shorthorns, and this name to most breeders expressed a different type with certain qualities very desirable in modern time. The same has occurred in all breeds, though the origin of the families may differ. For instance, in the Jerseys a great many families trace to a noted cow that has been an exceptionally high performer or to an equally noted sire. In this way the Coomassie traces back to a remarkable cow of that name, while the Tormentor family have their origin from a prominent sire of that name that is very successful in getting high performing cows. In Holsteins—and, in fact, in all other breeds of cattle—the same divisions have taken place. From this we see that all breeds branch out into families, and in the study of pedigrees the standing of these families in regard to their performances should be known.

It is quite common in naming families to adopt the plan of attaching an affix, such as 2d, 3d, 4th, etc. For instance, in the Shorthorn the founder of the Duchess family was a cow of that name, and her daughters were called Duchess 2d, 3d, 4th, etc., and the family continues solely through female line of descent. It should be remembered that the affix 2d, 3d, etc., should be applied only to the calves of the animal bearing the name used and of the same sex, and not applied to the progeny of the second or succeeding generations.

APPRECIATION OF PEDIGREES.

Having outlined the various processes through which a breed is formed, it will now be advisable to consider the nature of pedigrees and the means of judging their value and reliability. A pedigree is but a recorded statement of an animal's ancestry. The common animal—the one that we call a scrub—has a pedigree just as truly as a purebred, the only difference being that the pedigree of the purebred animal is recorded and may be traced out, while that of the scrub is not known; and so in the early history of the establishment of the different breeds pedigrees had a value which was as fully justified by merit as those of the present day. When the breeds were in process of formation and there were no herd-books, stud-books, or flock-books, it was more or less common for stockmen to keep the records of their best animals—or at least have their individual excellencies—in mind, and when these registration books were formed these were always the first animals to be recorded. As they were the best it soon became the belief that an animal with a pedigree was of more value than one without it, no consideration being given to the nature of the pedigree. While pedigree and performance were thus connected in early times, it was not long until pedigrees under such conditions were estimated too highly, and it became common to suppose that the animal with the longest pedigree was the one that had the best breeding and would be the most valuable. At this time it is quite evident, however, that such a position is not tenable. It is not the length of the pedigree which gives it value, as there are other features which should have more prominence given them. The three requirements of a pedigree are reliability, completeness, and merit in the animals included in it. It will be remembered that, in the formation of herd-books, when the secretary received the name of an animal he assigned it a number, and afterwards published a book giving the name of its numbers and breeding. Accompanying the name of a purebred animal there is always a number following it, and after that certain initials. For instance, if it is a Jersey, you will find the name of the animal stated before the number and likely the initials A. J. C. C. This all means that the animal whose name has this number is recorded in the American Jersey Cattle Club registry, and the initials are simply directions for finding the name of this animal in the record book. The reliability of the pedigree is covered altogether by the character of the association which published the record, and, to a considerable extent, to the integrity of the breeder.

As the different associations differ in their standards of entrance, it is important to know which are supported by the best breeders and are recognized by the United States Government. Further, if the breeder keeps his records carefully and sends them to the secretary, and the latter is supported by a reliable association there is hardly any question permissible in regard to the genuineness of the pedigree. As there are different associations publishing records for the same breed, it is very important for the beginner to know the initials used by all of these, and be posted especially as to their standing. It may detract one-half from the value of an animal to be recorded in a herd-book which does not have the support of the best breeders or one that is lax in its requirements of registration.

In judging the completeness of the pedigree it should be noted that the ordinary way of publishing pedigrees does not give all the ancestors as completely as they should be given. A complete pedigree should be traceable for at least six generations. When all the sires and dams in the ancestry are given for that length of time, then the pedigree may be said to be complete; but if any of the ancestors are lacking, it is termed "short bred." In the case of pedigrees of imported animals, it is only necessary that they should run back to the importations to make the pedigree complete. Most of the associations simply require that animals must trace to imported stock on both sides. As a rule, American herd-books do not give the breeding any further back than to the stock imported, as this meets their requirements.

With reference to the common form of presenting pedigrees, it will be noticed that different breeders of different classes of stock follow different methods in this particular. The breeders of Shorthorns, and some other cattle breeders, simply give a statement of the sire and dam of an animal and then mention the dams in successive order, thus leaving out the breeding of the sire's side. In all cases, to make the pedigree complete, unless it is given as a footnote, it is necessary to go to the herd-book to follow out the breeding of a sire. When all the lines are traced out, then the pedigree is said to be tabulated, and a form is issued from which you can see at a glance every ancestor that enters into the pedigree for at least six generations. There are various forms of a pedigree, but the most common method is to use braces. The name of the animal is first given, with such other data as will be necessary to identify it, and then an ordinary brace is used. The sire is placed above and the dam below; then another brace follows the name of the sire and at the top again of this brace the sire is given and the dam below. This procedure is carried out until they all appear in complete form. To make this clear, a Shorthorn pedigree in condensed form, and also as it appears when tabulated, is submitted.

Having the pedigree traced out complete, the most important matter of all is in the determining of the merit of performance of each animal that enters into the pedigree. It is this which largely determines the actual value of the pedigree. The fact that an animal's pedigree is traceable for fifty generations does not add to this pedigree's value if each animal in that pedigree has not had sufficient merit attached to it. Suppose we are looking to the pedigree of a Jersey. We have it traced out and tabulated, and we wish to determine its merit. The Jersey breeders have an official book of butter tests, and to this we turn for information. We first look up the animal whose pedigree we are tracing and ascertain if she has been officially tested and see what she has done. We then refer to her sire. From this book of butter tests we ascertain if this sire has produced many heifers that have tested high, or if he has transmitted qualities of this kind and has got sons which in turn have produced high-performing cows. We arrange all this under its sire. We then refer to the dam of the cow we are investigating to learn if she has been a heavy performer with a large test, and also to find out what her daughters have done as performers. We notice, too, if any of her sons have been producers of high-testing cows. In this way we look up the performance of every animal named in the pedigree, bearing in mind that it is the performance or the test of each animal in that pedigree which does most to determine its value. If it were a Holstein pedigree that we were looking up, we would turn to the official records of this breed published by the association, and more especially to what is called their Advanced Registry. The following is the usual form of condensed pedigree, taken from page 638, Volume XL, of the American Shorthorn Herd Book:

COLLEGE MOORE.—Light roan, calved October 19, 1891, bred by Iowa Agricultural College, got by Chief 102149, out of May Moore 11th (vol. 36, p. 577), by Proud Duke 2d 88757—tracing to imp. Young Mary by Jupiter (2170).

This pedigree, traced out and tabulated, shown on page 428, shows the several lines of breeding in it.

In this registry they include cows that are not only purebred Holsteins, but they also meet the requirements of the Advanced Registry for performance. In the same way, if we are looking up the pedigree of the standard-bred horses, we would refer to the yearbook published by the American Trotting Association, and in this way see how many horses in that pedigree had records or were getters of horses that could trot and had secured records. In those instances where there are no official records to go by, such as in the case of beef cattle, the show-yard winnings and the sale reports are used to take the place of other records. The practical feature of this is that when this characteristic of high performance is duplicated through each animal named in the pedigree, the stronger bred and the more prepotent is the animal whose pedigree we are studying. It requires deep study on the part of the breeder to keep posted on the performance, the sales, and the winnings of the different representatives of the breed receiving his attention, but he must do this in order to keep informed as to the standing of his herd.

To be able to read a pedigree and easily understand its value, it is necessary to know the purpose of the different families of the breed. As a breeder of dairy cattle, he must know what each family has accomplished in the past, so that when he sees the name of an individual of any family he knows just what it is worth in a pedigree, because he is well acquainted with their performances. In trotting horses and all other classes of stock which have records of any kind on which to base their merit this is equally true. For instance, the breeder of trotting horses will take a pedigree and, looking at the first name with the breeding that is back of it, will be able to see just what family that pedigree represents. Inferring that he is looking at the pedigree of an animal that was sired by George Wilkes, he knows that George Wilkes was the founder of the great Wilkes family; and, as he has posted himself on this horse's *history* and performance, he knows the breeding of

College Moore (vol. 40, p. 638, A. S. H. B.): roan; calved Oct. 19, 1891. Owned by Iowa Agricultural College; bred by Iowa Agricultural College. Record milking period from Oct. 21, 1896, to Nov. 30, 1897; milk, 9,136 lbs.; butter, 404 lbs.; cost of butter per lb., 6 cts.; profit, $40.62. Record milking period from Feb. 26, 1898, to Feb. 28, 1899; milk, 8,734 lbs.; butter, 41[illegible] lbs.; cost of butter [illegible] cts.; profit $37.75. Record milking period from Oct. 1, 1899, to Oct. 31, 1900; milk 9,896 lbs.; butter, 174 lbs.; cost of butter, 5 cts.; profit, $81.60.	Chief 102149	Handy Andy 70048	Duke of Oxford 46th 38	Imp. 4th Duke of Clarence 26188.	8th Duke of Oxford (25995).
					Duchess 109th.
				Imp. Grand Duchess 29th (vol. 16).	Baron Oxford 4th (25580) 4752.
					Grand Duchess of Oxford 19th.
			Mattie Handy (vol. 30)	2d Kirklevington Duke 39526.	4th Duke of Airdrie 7879.
					2d Duchess of Kirklevington (vol. 15).
				Virginia Rivers (vol. 30)	8th Prince of Boyle 27587.
					Raeflla 5th (vol. 7).
		Luda 17th (vol. 20, p. 15904).	Rural Duke 24747	2d Duke of Oneida 9926	4th Duke of Geneva 7931.
					13th Duchess of Thorndale.
				Luda 5th (vol. 10)	Duke of Mason 5589.
					Luda 3d.
			Luda 3d (vol. 10)	Burnside 4618	Duke John 2741.
					Imp. Bracelet.
				Luda	Milo 709.
					White Rose.
	May Moore 11th (vol. 36, p. 577).	Proud Duke 2d 88757	6th Wild Eyes Duke 41286.	Imp. 4th Duke of Clarence 26188.	18th Duke of Oxford (25995).
					Duchess 109th.
				Wild Eyes of Horton Park (vol. 16).	Grand Duke of Clarence (28750) 10041.
					Wild Flower Duchess.
			Meadow Lark 5th (vol. 19, p. 14700).	Geneva Duke 19481	4th Duke of Geneva 7931.
					Duchess 6th.
				Meadow Lark 4th (vol. 16, p. 12228).	Fidalgo 14243.
					Meadow Lark 2d.
		May Moore (vol. 17, p. 13050).	Sam Jr. 15431	Old Sam 10551	Duke of Grafton (21594).
					Roma.
				Mazacco 2d	17th Duke of Airdrie 6629.
					Mazurka 20th.
			Beauty (vol. 12)	Consul 13711	11th Duke of Thorndale 5611.
					Constance 5th.
				Clara Barton	Alexander 7482.
					Red Rose 2d.

each animal that is behind the name of George Wilkes. He realizes that each animal in that pedigree has been bred for a certain purpose and has the trotting instinct, and that the horse having this pedigree is likely to possess this also.

It is a noteworthy fact that certain families seem to be especially fruitful in high performers when they are blended together. This means what has been called a "nick in breeding," and it is necessary for a breeder to know the strains which blend most successfully. To become posted in this direction it is necessary to study carefully the breeding of all animals that show high performance. As an illustration, reference may be made to the union of the Hambletonian and Mambrino Chief families in the production of fast trotters. The union of these two families has resulted in the production of more standard horses than almost any other line of breeding simply because they seem to be possessed of qualities which "nick," or produce, a properly balanced progeny. To estimate pedigrees properly, the breeder should be familiar with the breeding of the most noted animals, so that he may know the lines that they produced. It is very necessary for the breeder to know the records of the different families as far back as possible so as to lessen the risk which attends his work. There is so much uncertainty in regard to breeding domesticated animals that a breeder should not be willing to take any chances whatever in regard to the pedigrees of the animals which he has in his herd. To indicate how important a matter this is to the breeder, let one or two instances be cited of the value of having an animal's pedigree contain only proper individuals. There are instances where a breeder's work has been completely ruined through the use of an animal with some flaw in his ancestry.

Mr. Sidney, one of the most reliable live-stock writers, states that in a litter of Essex pigs there were two young ones that were the exact image of the Berkshire boar that had been used twenty-eight years before for giving size and constitution to the breed. Here is an instance of an animal asserting himself through his markings after twenty-eight years of continuous effort to remove his influence in this direction. Mr. Walker, a large dealer in cattle in Scotland, bought a black polled bull, probably a Galloway or an Aberdeen-Angus, that was out of a cow of white legs, white belly, and part of the tail white. These markings are not desirable in this breed, but it was thought that they would not likely reappear. The remarkable part of the statement is that the great-great-great-great-granddaughter of this cow was born marked in exactly the same peculiar manner, and all of the intermediate family were black. In this instance there were five generations intervening between the appearance of this cow in the pedigree and when this calf was born, and yet such small features assert themselves after very careful efforts to eliminate them.

To secure the greatest reliability in a pedigree, or what is known as prepotency, the animals in it must have uniformity; that is, they must be bred toward the same purpose, and there should be a decided tendency toward a uniform type. It is easy to understand that the constant reproduction of a certain type or form through successive generations causes this type to become fixed, and the other qualities associated with it are also likely to be transmitted with the greatest certainty. It is possible through cross-breeding, or the mating of animals of different breeds, to secure remarkable animals in the first cross, but it has been especially noticeable that these animals are generally unsatisfactory for breeding, as they do not transmit the qualities they possess with certainty. It is because of this that uniformity should be sought in the type and characteristics of all the animals entering into the pedigree.

SELECTION OF A BREED.

After studying and investigating along the lines which have been previously discussed, the novice is then in a position to take into consideration the practical details of establishing a herd or flock of pure-bred stock. At this point the most important feature to consider is the selection of a breed. This implies much study and carefulness in order to understand the characteristics of the breeds so that there may be no conflict between environment and their characteristics. It is very necessary that the breed should be adapted to the breeder's locality. Perhaps there is no single feature which has more influence on the future success of the herd or flock than the careful consideration of adaptability to locality. The aim should be to select a breed which is in complete harmony with its environment. In this way advantage is taken of the many years of careful work which previous breeders have done in developing the characteristics. If the environment should be opposed to the characteristics, it would be a continual effort to maintain them, as there would be a constant conflict between these features. Knowing the soil, climatic, and other conditions which surround the breeds during their formation and through the period of their after development, it becomes an easy matter for one who is thoroughly informed on the conditions of his own farm to choose a breed that will surely thrive and progress under conditions imposed on it; but, in addition to these factors, the system of management of a farm would more or less influence the selection of a breed. If the farm is of such a nature as to return the more profit when grazed instead of being devoted to grain growing, then a breed of stock possessed of activity and abundant constitution, with grazing qualities, would meet the requirements in the most satisfactory manner. There are certain breeds noted for their ability as grazers, while there are others equally prominent for their ability to utilize the produce of a grain farm. This distinction must necessarily be in the mind of the beginner of the work of establishing a herd or flock.

LAYING THE FOUNDATION.

In laying the foundation for a herd or flock, it is the best policy to secure a few exceptionally good animals rather than to attempt to build up a herd rapidly by the addition of many showing mere average merit. The reasons for this are many, but the most striking one may be readily seen by an inspection of any large herd where the proprietor will consent to freely discuss the inner details of the development of the herd. It will invariably be found that the reputation of such a herd, no matter how extensive it is, has been built upon the performance record or conduct of a few remarkable animals. These are generally of one strain, and possibly tracing to a single animal that was added to the herd at an early date. Perhaps an exceptional sire has been secured, and the reputation of the herd made on this. It will prove surprising to anyone investigating this feature to realize the number of instances in which this fact is plainly in evidence. It emphasizes very strongly the importance of careful selection of the foundation stock, for there are years of work ahead in building up the herd; and if the foundation has not been laid with extra care, rebuilding may be necessary after years of strenuous effort have been devoted to it.

In the selection of foundation animals it should be a cardinal principle to secure as much uniformity in type and characteristics as possible. This implies that the foundation stock should not only represent very similar lines of breeding, but they should also show uniformity of type. This may not always be possible, but it should be one of the things which the beginner should have in view. The test of the breeder's skill is largely the uniformity of the product which he turns out. If all his stock show a uniformity of type, and that type is desirable, it is going to be a strong feature in advertising his herd and making its product in demand.

ESTABLISHING A TRADE.

After the breeder has his herd or flock established, the question of disposing of the surplus stock becomes an important one. It is at this time that the business side of the work begins to appeal to him. The development of this is dependent on a great many conditions, some of which have been considered. The location of the farm is one of the matters which influences a business, and it should previously have been thoroughly considered. If the stock are such as are in demand locally, they may meet with ready disposal without having recourse to outside patronage; but, if not a stock community, a different line of procedure is necessary. As a matter of fact, the local demand is never such as completely to support a satisfactory herd or flock. To build up an extensive business in the breeding of stock, it is important to have good connections with a territory needing this. A stock farm on the main line of a railroad has a leading advantage in that it is accessible to those wishing to see the stock and the shipping facilities, and rates may materially influence the profits.

However good the herd or flock may be, it is absolutely necessary for the progressive breeder to keep in touch with his patronage by judicious advertising. The chief medium of advertising is the farm paper and the live-stock press, and when the beginner has secured the confidence of these a very material advantage has been gained. In addition to advertising it in the public press, the question of showing at the leading fairs is one that should be discussed in this connection. The awards of the show ring are undoubtedly valuable to the winners of them for advertising purposes, and it is well for the breeder to have in mind the securing of these at opportune times. However much it may cost in the way of actual expense and the sacrifice of some animals, there is no doubt but that the show rings offer the most satisfactory method to the public of measuring the merit of the animals in one herd against those of another.

To assist in the disposal of surplus stock, there is perhaps no more satisfactory method than that of the combination auction sale. By this is meant the joining together of a sufficient number of breeders to hold an auction sale of surplus stock at some central point. The main advantage of this to the beginner is that it enables him as a small breeder to share in the advertising advantages and sale privileges secured through his connection with the breeder, whose operations are more extensive. This means also the securing of an attendance of buyers who would not under other circumstances see the stock of the small breeder. Another feature which adds to the value of the combination auction sale is the fact that it means a quick disposal of the surplus stock, and very frequently the stimulation of the bidding in the auction ring results in better prices than those which might be obtained by private sale. Considering the advantages to the small breeder, together with the ready sale and quick completion of the transaction, the combination auction sale is sure to become a factor in the development of our herds and flocks.

When the stock is sold the breeder's obligation does not by any means stop at this point. To complete the transaction, the pedigrees of the breeding stock should be furnished as promptly as possible, and it is the most satisfactory, as a rule, for the sellers to also furnish transfers. It is the general practice for the sellers to omit the details of making a transfer unless an understanding has been made between the buyer and the seller, but it is a growing practice for the latter to furnish the papers complete. Some of the associations do not require any transferring, but they are so few that it may be said in general that in addition to getting the pedigrees of this stock the buyer should also secure the transfers.

MARKET CLASSES OF HORSES.[a]

By George M. Rommel, B. S. A.,
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INTRODUCTORY.

The growth of the horse market during the past few years, its present healthy tone, and the apparent promise of a continuance of these conditions for at least a considerable time to come, warrant the bestowal of time and attention, not only upon the general demands of the market, but also upon rather detailed examinations of the various kinds of horses that are wanted.

In this article the market classes are generally referred to in the colloquial terms of the market. This, it is thought, will, to a considerable extent, tend to prevent confusion and misunderstanding. Aside from casual references, no attempt is made specifically to discuss breeding or fitting for market.

For convenience, all points of an anatomical nature are grouped under the head of "Conformation." Although according to the generally accepted usage by the best authorities on score-card practice and live-stock judging, this is a somewhat broad use of the term, it is not technically incorrect, and the advantages gained by the elimination of details that might prove wearisome will, it is believed, warrant such treatment.

The classifications here considered are made as comprehensive as possible, embracing the views of dealers in all of the principal markets of the country. All the classes mentioned will not be found present in all markets, nor will all markets have exactly the same qualifications, but these differences are so slight as to be practically unimportant.

Especially in regard to size and weight, it must be borne in mind that the figures given are not arbitrary. Not only will they vary in different parts of the country with different markets, but dealers in the same market will differ in their ideas as to the exact sizes and weights of the various classes. With this, as with all points, the attempt has been made to strike an average—to obtain a consensus of opinion, as it were. It is always to be remembered that "doctors differ," both as to the symptoms of a patient when ill and as to his normal appearance and proper conduct when well.

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[a] Published also as Bulletin No. 37 of this Bureau.

Prices are seldom mentioned here, for the reason that they are subject to continual fluctuations, and any that might be quoted would be serviceable only for the time of writing. Such information is accurate only when gained from regular market publications, and is easily obtained.

For specific information regarding contemporaneous market conditions there is no better or more easily approached source of information than the commission firms and dealers on the market, whose courteous assistance, it should be mentioned, has made this article a possibility; and no better school for practical instruction can be imagined than an auction ring in one of our great horse markets on a sale day during the height of the season.

PRIMARY CONSIDERATIONS OF THE MARKET.

A general observation of the horse markets in the United States reveals very different conditions from those existing in the early part of the last decade. Before going into details and ascertaining the kind of a horse that the several demands on the market require, we shall find three conditions which present themselves for consideration:

First. The market is seen to be on a much firmer basis than it was in the years from 1893 to 1897. Not only are prices much higher, but, generally speaking, the competition among buyers is keen, and a serviceably sound, well-set-up horse of the right type, in good condition, can almost always be disposed of at a profit to the producer.

Second. One is impressed with the pronounced scarcity of animals of the better grades, especially among light horses. Dealers can not satisfy the demands that come to them for high-class roadsters, coach horses, and saddlers. Even among "business horses" a higher price must often be paid than buyers desire, and it is said that this has even led some large establishments to send agents into the country to take advantage of the natural differences between farm and market prices. To a casual observer this is, perhaps, the most striking feature that presents itself. A change from a condition of overproduction and panic prices to one of scarcity and strong prices has come about within the course of less than five years.

Third. Going more into the details of the market, we find a pretty well-defined system of classification. Buyers are on the market to get horses of a certain type, and thus have created "classes." It is true that there are still thousands of horses every year that are shipped in simply to be gotten rid of—to sell for whatever they will bring—yet they are, as a rule, sold at a loss, and the only horses that sell at satisfactory prices are those that conform to the requirements that buyers demand.

The reasons for these conditions are rather definitely understood, but a brief review of them here may not be out of place.

CAUSES OF THE DEPRESSION OF THE LAST DECADE.

Going back of the firmness of the present market, the causes of the low prices and overproduction that preceded it are interesting subjects for study.

PASSING OF THE STREET-CAR HORSE.

The recent depression of the horse business began about 1890. Up to that time immense numbers of animals were in demand for street-car use. A fairly good animal was used, but there was no certain fixity of type. This trade absorbed very many horses that had always constituted the overwhelming majority on the market—the small chunks and the general-purpose animals; and with the introduction of the cable car and, almost immediately after, the sweeping substitution of electric cars for horse cars in nearly all the large cities, these immense numbers of horses were thrown on the market without a demand for them, and the public was suddenly confronted with a condition of extreme overproduction. This, however, would only indirectly affect the higher grades. Extra individual horses maintained a fairly good scale of prices, and never at any time were they such a drug on the market as the commoner sort.

The severest test to the horse market was yet to come. Strongly organized conditions might have tided over the effects of oversupply that the falling off of the demand for the street-car horse brought about, but the punishment was to be made all the more complete by the financial panic of 1893.

THE FINANCIAL PANIC OF 1893.

The great panic that began in this year, but whose influence was felt most severely in the horse-producing sections two years later, was really the most effective cause for the breakdown in the horse market. The cheaper grades fell still lower and the higher classes began a descent in prices that forced men out of the business and had a most disastrous effect in creating a general distrust of the horse, not only on the part of men who were already engaged in his production, but also with prospective producers. All classes of stock were affected, but it was the horse breeders who had the worst "scare," and it was freely predicted that horse raising would never again exist as a factor in live-stock husbandry.

THE BICYCLE AND THE MOTOR CARRIAGE.

On the heels of the panic came the bicycle, and in a few years the motor carriage followed. The bicycle influenced particularly the demand for cheap drivers—the inferior grades—and naturally intensified the downfall of prices. However, though for a time the growing use of the bicycle brought about a decline in the use of horses, its effect was hardly so severe as appeared; certainly it was not permanent. The use of the bicycle became most widespread among persons who could afford neither to purchase nor maintain a horse and among those who constitute a large part of the patronage of livery stables. If it has severely affected the horse in any capacity, it is by the inroads that liverymen claim it has made on their business. The most effective force for furthering the downfall in prices was simply fright, which brought about an unnecessary unloading of horses on a market already oversupplied. The results after the lapse of a few years, and the adjustment of the bicycle to its proper place as an important economic factor, with the return of the business to normal conditions, give ample reason for such opinions.

Experience with automobiles has shown that in their present state of development their effect on the horse market is not serious. For business purposes they have not yet been found to be entirely satisfactory, whereas the bicycle has become an invaluable adjunct of business. At present the "auto" is the least dangerous of all the deterring influences that operate against the horse market.

CAUSES OF PRESENT SCARCITY.

THE DECLINE OF HORSE BREEDING.

The lack of confidence in the horse-breeding business which resulted from the depressing influences of the panic period undoubtedly brought about a decline in the breeding of the best grades. This can not be shown very accurately, for the Twelfth Census has reported the largest number of horses in the history of the country. By a careful study of the market conditions, however, it is evident that a more exacting market has found an inferior grade of horses from which to draw its supply. Misfits and culls are common enough, but they are not in demand. The scarcity that exists to-day is most apparent among the better grade of horses, and we are forced to the conclusion that these horses have rapidly decreased in numbers, while unsalable, inferior sorts have increased. The period of low prices caused men to stop breeding good horses, but failed to stop the progress of the scrubs.

THE EXPORT TRADE.

Almost coincident with the beginning of the panic of 1893, a new force began to operate to offset the disastrous conditions of the horse market, so that while this date marks the beginning of the severe downfall in prices, it also marks the beginning of their revival.

The World's Fair year (1893) brought to the United States among its visitors those whose search for good horses for export, directed toward the great markets of the West, was to be the rejuvenating force that would once more place the horse in his rightful position as a revenue producer for the farm. The effect of the demand they created was an almost instant rise in prices of the better grades. Inferior sorts were only sympathetically affected, for it is not profitable to ship anything but "toppy" animals. The growth of exports was tremendous. From about 3,000 in 1893, they have increased fifteen times over in seven years, and to all appearances the demand is by no means yet satisfied.

The exporters entered the market with a call for horses of definite qualifications that have been rigidly adhered to. Reckless methods would not and can not pay in supplying this market.

The following statement of exports for the fiscal years 1890 to 1901, inclusive, shows an enormous growth:[a]

Exports of horses for the fiscal years 1890 to 1901.

1890	3,501
1891	3,110
1892	3,226
1893	2,967
1894	5,246
1895	13,984
1896	25,126
1897	39,532
1898	51,150
1899	45,778
1900[b]	64,722
1901	82,250

The demand for so many animals for export very greatly increases competition, and, as it represents a much broader field for the market to cover than formerly, it is a second cause for the apparent scarcity of good marketable stock. This trade is the means by which surplus stock may be marketed and good prices maintained. If no more horses are produced than are needed for our own uses, it will generally happen that the export trade can not exist; for home buyers can nearly always pay better prices than exporters, and it is easily seen that, when the supply is short, a strong market may exist independent of foreign demand. Information received within the last two months indicates that such conditions are largely present at this time. There is still a large demand from abroad, but prices have risen to such an extent that this trade has been very much diminished.

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[a] From reports of Bureau of Statistics, Treasury Department.

[b] The shipments to Africa during the last two years are largely responsible for the great increase for the years 1900 and 1901. This is shown as follows:

For fiscal year ended June 30, 1899	127
For fiscal year ended June 30, 1900	10,220
For fiscal year ended June 30, 1901	37,465

These exports, developed under abnormal conditions, must not be looked upon as permanent.

GROWTH OF THE LOCAL DEMAND.

With the growth of the export trade, the great increase in the demands of the local market has required horses in large numbers. The increase of population, with a growing love of a good horse, and the wonderful growth of business, call for many more horses than were needed for such purposes in the early "90's." The exacting nature which characterizes the foreign demand is also coming to be a notable feature of the home demand.

This third cause—the local demand—combined with the export trade, makes a broader market. Undoubtedly, there are as many horses in the country now as ten years ago, though perhaps of an inferior quality, but relatively there is a great scarcity.

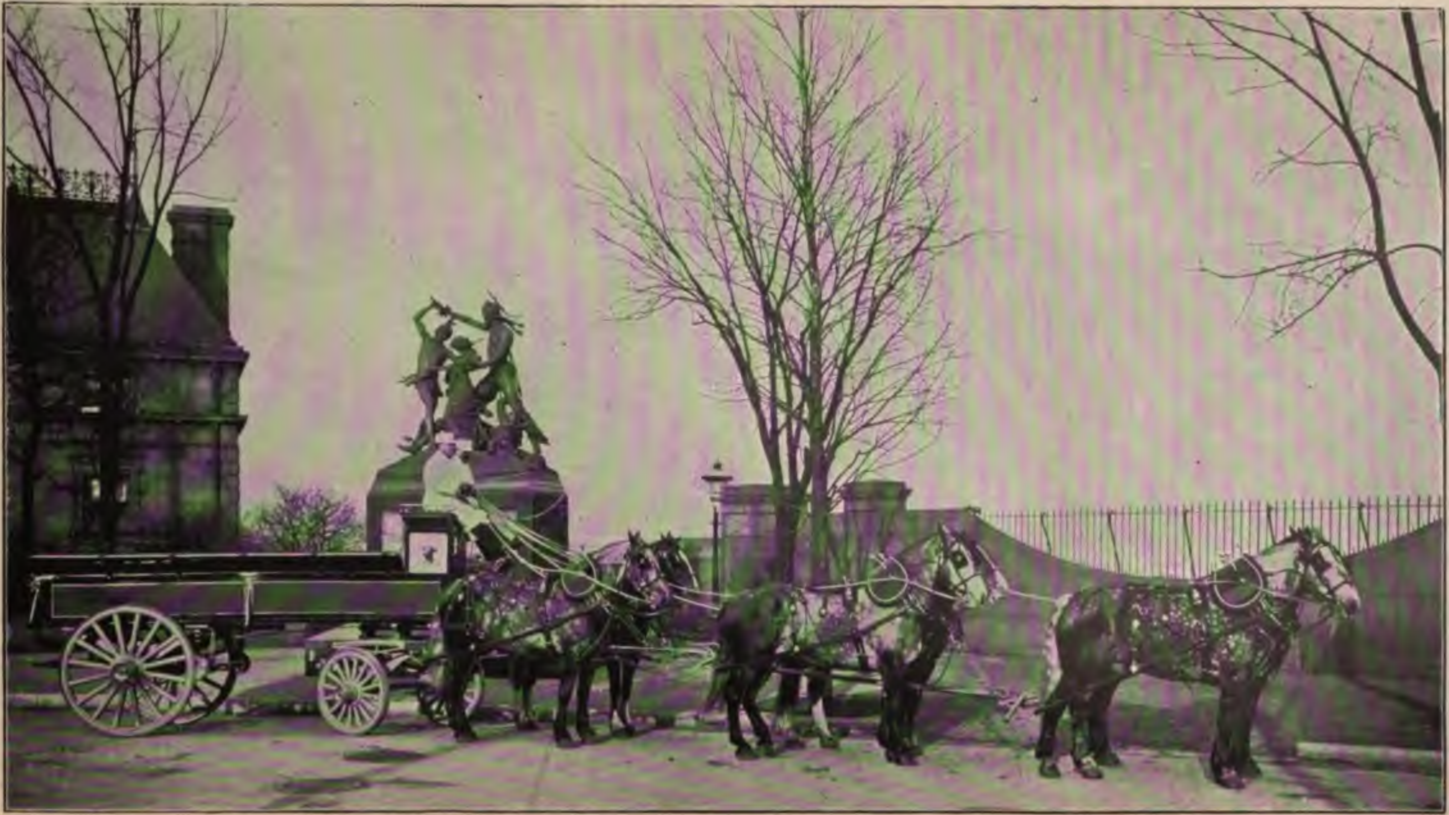
GENERAL CONSIDERATIONS OF THE MARKET.

WHAT CONSTITUTES A MARKET CLASS?

By a market class we mean the demand that exists for a horse of certain characteristics definitely specified. We find the requirement that certain work shall be done in certain ways. This requires a horse of certain size, conformation, style, and action, and becomes more exacting as time goes on and the demand for such a horse increases. For this reason it is readily seen that classes on the market at one time may be cut off by reason of a change in the kind of work to be done or a change in the method of doing it; such, for instance, as the substitution of electricity for horses as a motive power for street railways. On the other hand, we have an illustration of the creation of new classes in the opening up of the English demand for the omnibus horse. The increasing demand for hunters for both the local and export trade and the brisk trade in polo ponies are also instances of such conditions. The kind of work and the manner in which it is to be done, therefore, develop the buyer's demands and thus create the market class.

WHEN WILL A HORSE SELL WELL?

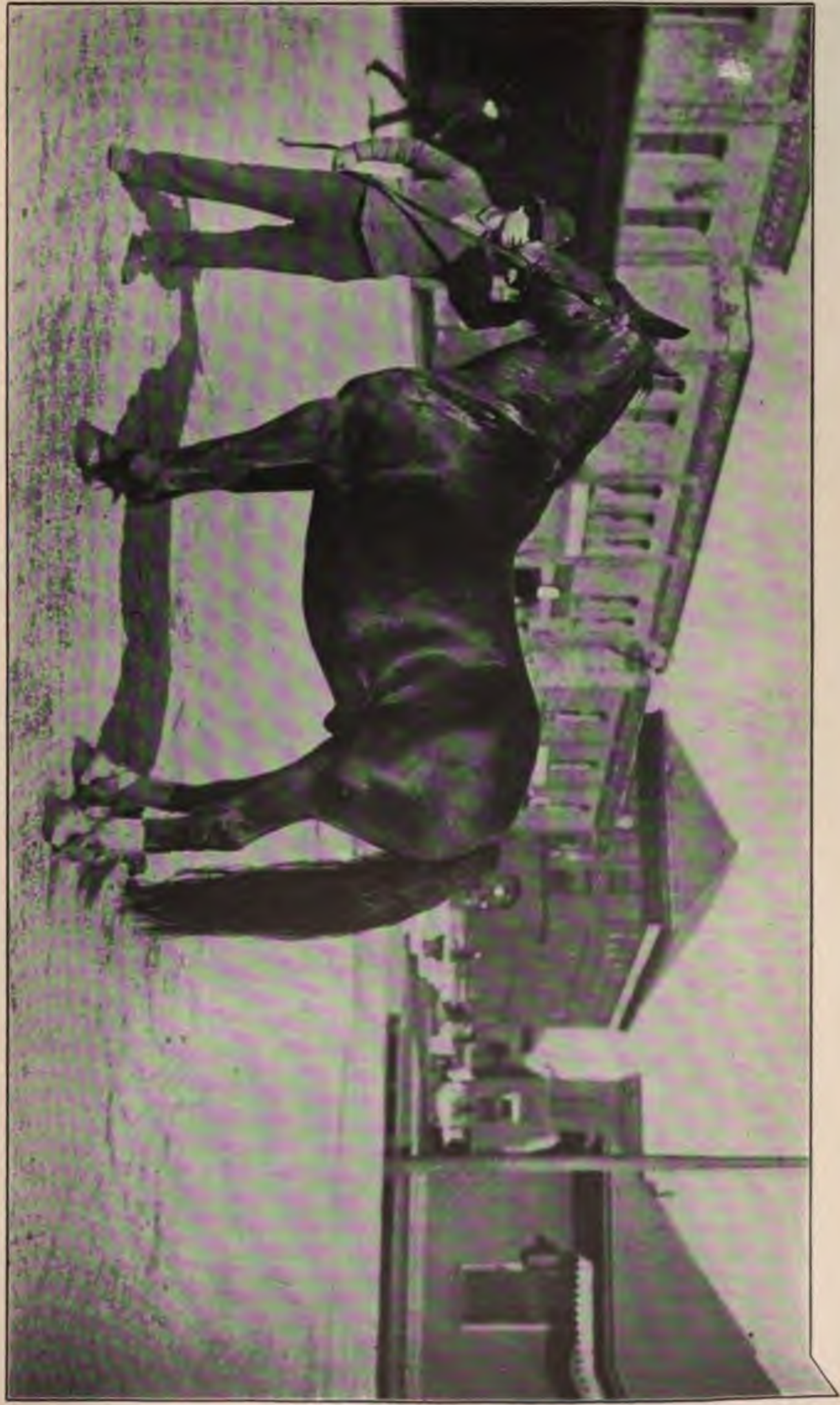
The question naturally arises, When will a horse sell well? This is answered in describing the requirements of the various classes, which is done elsewhere in this bulletin. An animal will be in good demand when he meets the qualifications of a market class; the more clearly he does so the greater demand there will be for him and the higher will be his selling price; and a horse that goes into a class because his breeder was successful in breeding him for that class is much more likely to sell profitably than one that drops into a class as the result of an accident in breeding, handling, or fitting for the market. A breeder must determine for himself whether he can produce such a horse and dispose of him at a profit. That he will find a good demand for animals of the right type is quite certain. The individuality of the horse himself, then, will indicate his class.



Photograph furnished by Swift & Co.

A PRIZE-WINNING CROSS-MATCHED DRAFT TEAM.

These horses faithfully represent the class purchased for American city use, though not of extreme weight.



Photograph by Lawrence.

The Draft Type

PLATE LXVI.

GENERAL ESSENTIALS OF A MARKET HORSE.

Before taking up the details of the various classes it may be well to consider the essentials that all classes must have—the requirements of a drafter as well as a coacher, or of a busser as well as a cob, roadster, or saddler.

AGE.

Mature and well-broken horses are always the best sellers. A year or two spent in waiting for a horse to develop and educating him means an expenditure of time and money on the part of the purchaser, which is, as a rule, undesirable unless the horse is bought specifically for the purpose of fitting him for the finished market. The ideal age is five years, buyers usually purchasing animals ranging from five to eight. The classes vary somewhat in this respect. A horse intended for draft purposes may be marketed somewhat sooner than a harness horse or saddler.

BREEDING AND SEX.

The breed to which a horse belongs has very little influence on his selling price. All that is required is that he be a good individual of his class. A good horse always sells. Geldings are preferred somewhat generally to mares.

COLOR.

Color does not figure so strongly as many would lead us to believe. Almost any color with excellence to back it will sell well, except white, flea-bitten gray, "mealy" bay, or any other color that might be termed "washed out." Among drafters no special color seems to have preference; with harness horses and saddlers, bays, browns, and chestnuts have first preference, but grays and blacks sell readily if "good." Well-matched teams, both in harness and draft classes, usually bring higher prices than if sold singly.

CONDITION.

Condition is very often overlooked. It is absoluely essential that a horse be in good condition (well fed) to bring what he is really worth. This is particularly true of animals of the draft type. Whether it increases the animal's real value as a worker is not necessary to consider. The market demands high condition and pays those men well who cater to it. The great lack of condition is shown by the fact that many horses are sent in for sale only to be reshipped to the country for further feeding. Condition is almost as essential as fat on a steer, and its absence cuts from 25 to 50 per cent from the selling price of a a horse. The requirements of the market in this line are well worthy of notice.

DISPOSITION AND INTELLIGENCE.

Every class calls for an animal of intelligence and good disposition, willing to pull at a good rate or set a fast pace on the driveway, and capable and cool-headed in an emergency. The use of horses on crowded streets, often among large numbers of pedestrians, make the latter particularly essential. The need of these qualifications is more important in some classes than in others.

THE MARKET HORSE IN DETAIL.

SOUNDNESS.

The most important requirement of a market horse is "serviceable" soundness; that is, he must have no chronic disease that will unfit him for work of a general nature. He must be sound in wind and in limb, able to do a reasonable amount of work without undue fatigue or premature breakdowns. The majority of the horses sold from a great market go to the city trade and are compelled to do their work on hard, unyielding pavements, pulling heavy loads, or developing speed that is an even greater strain on the feet and legs. The average period of usefulness on city streets of a horse that was sound at the start is not more than five years, and it is manifestly evident that this time will be materially decreased if he begins this work in an unsound condition. Broken wind, sidebones, unsound hocks, and all the various other ills that a horse is heir to should be strenuously guarded against, as they greatly diminish his value.

CONFORMATION.

The next requirement, then, is a conformation that will enable an animal to do hard work with a minimum of wear, and give him the longest possible period of soundness. Special emphasis should be placed on the foot, which should be of medium size, with hard and dense horn, plenty of height to the heels and plenty of room between them, a large elastic frog, and a nicely hollowed sole—in short, a sound, durable foot. The pastern slopes well, corresponding to the slope of the shoulder. These conditions—with flat, fully developed muscles, strong, clean cut, well-developed joints, strongly supported knees and hocks, clear, clean-cut tendons standing well out from the leg, and dense bone of a quantity sufficient to sustain the weight of the horse—will give a limb well calculated to withstand the wear and tear of a city pavement.

Joining the fore and hind quarters we must look for a deep, fairly wide, and compact middle piece, with ample room for chest organs, and no pinching at the waist. Too much width should be avoided, as the action of the forelegs is almost sure to be bad with such a conformation. A short back is generally sought, especially one which shows the least possible amount of space between the last ribs and the hips, giving a "close coupled" horse. This is almost as essential as a sound foot. A long, loose-ribbed, open-jointed, wasp-waisted animal is especially to be avoided. Such a conformation indicates lack of strength and forecasts an early breakdown. The shoulders should be deep and smooth, and hind quarters deeply muscled, wide and well rounded. A sloping rump is always unsightly and detracts both from the use and value of the horse, for it stands to reason that such a conformation can not furnish the same amount of muscle that a nicely rounded one can. The tail should be set high and smartly carried. Prominent shoulder points, hips, and buttocks are objectionable.

The neck should be clearly outlined, of moderate length, and well muscled, with a good crest. The head should be clean-cut and of moderate length, with a rather small ear, much breadth and fullness of forehead, a large, clear, full, intelligent eye, and a wide-open nostril, showing good lung power and consequent stamina. The mouth should be of good size, with sound teeth, and firm lips of medium thickness.

Over all these must be an abundance of muscle laid on smoothly and nicely rounded. Quality is highly essential, and the mistake of growing size without it will be found expensive. A close connection between quality and stamina is very clearly recognized by horsemen.

HORSES FOR DRAFT.

Any horse the purpose of which is to draw large loads, whether at the walk or trot, may be spoken of as a "horse for draft." Common usage has fixed the term "draft" on horses of specified weight and size, but there are other classes on the market whose conformation is what has come to be known as the "draft form," but which differ from the drafter in the matter of size and weight and the manner of performing their work. The drafter proper works always at a walk, while other classes of horses of draft type do their work mainly at the trot. As we go along, the close relationship between the different classes of this group should be noticed, for it is one of the most interesting and instructive features of the market.

THE DRAFT HORSE.

Size and weight.—The weight that will characterize a horse as a drafter will be that above which he can not work at the trot without waste of effort and horseflesh and below which he can work more economically by hauling smaller loads at increased speed. This weight is pretty generally conceded to be 1,600 pounds in fair flesh. The height of a drafter will vary from 15.3 hands for the smaller sorts to 17.2 hands for horses of great weights.

The importance of weight in a drafter must not be overlooked. His purpose is solely that of heavy work, pulling great loads at the walk, and to fulfill this requirement most perfectly the first essential is weight, with, of course, proportional size. Without weight the immense loads that are to be hauled over our city streets could not be moved, and careful observation of the average prices has shown that, other things being equal, draft horseflesh is worth about $25 for every additional hundred pounds it can show over 1,600 pounds.[a] It is also essential that as much as possible of this weight be bone and muscle. Though many buyers unquestionably demand fat, and the truth is that a horse can not sell for a creditable price unless fat, the effective value of a horse as a worker should not be lost sight of.

Conformation.—His conformation should enable the animal to make his weight as effective as possible, and, at the same time, assure a reasonably long period of usefulness. For this purpose, he must have a rather short, heavy neck and a shoulder sloping enough to take the collar well, but not so straight as to cause a "post leg" and bring about premature unsoundness. The back should be short, well muscled, and strongly coupled to the hind quarters, which should be nicely rounded, smooth, and plentifully supplied with muscle. Particular attention should be paid to the hock. The legs must be moderately short and have a supply of bone sufficient to support the weight and work of the animal, and, of course, must be sound. A short leg, with low-set knees and hocks, is one that will stand wear and tear and usually goes with a strong, closely coupled body. Head and neck should be proportionate to the size of the horse. The whole appearance should be massive.

Action.—The action of the driver is confined almost exclusively to the walk. For this reason the walk is of vital importance. Rapidity of step and length of stride enable him to cover considerable ground in the least possible time. Straightness, smoothness, regularity, and lack of friction enable him to do this with the least possible wear and injury to himself. The trot should possess all the merits of the walk.

Demand.—Horses of this description are in strong demand for use in city streets of America and Europe. The great packing houses, brewing companies, wholesale houses, and heavy dray and transfer companies buy this class of horse, differing slightly in weight, according to the purpose to which it is to be put or the desires of the purchaser.

The rougher, plainer drafters are used for the coarser work of the cities, where the style of a team is of no particular importance to its owner. The lumber trade takes such a horse, often buying animals that are blemished or even unsound.

The horse used for the American city trade is also in strong demand for the export trade to England and the Continent.

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[a] Craig. Judging Live Stock, p. 34.

THE LONDON VANNER.

The horse known in England as a van horse is very largely purchased on the American markets. He is simply a good, "toppy" American drafter, such as has already been described, weighing from 1,600 to 1,800 pounds, and standing from 16 to 16.2 hands, with a strong, compact body on short, strong legs, with sound, healthy feet. He is used to draw heavy drays, vans, etc.

THE SCOTCH, OR GLASGOW, VANNER.

This horse is about the same as the English as to weight, though he may be lighter, and is more upstanding—that is, on longer legs. His work is the same as that of other classes of horses intended for moderately heavy city work.

The horse that the Englishmen term a "cart horse" is extremely rare on the American market, and, when found, not always of the best quality. He should stand 16.2 to 17.2 hands, and weigh 2,000 pounds and upward.

THE EXPRESS HORSE.

After the drafter, the remaining classes of the draft type are distinguished by the fact that their work is done almost exclusively at the trot. The first of these is the expresser. This is one of the best and highest classes on the market so far as individual excellence is concerned, and horses that fill the requirements are always in demand at strong prices. An expresser is the best finished of all of the minor draft classes.

Size and weight.—The size and weight vary somewhat, as a matter of course, but as a general rule, an expresser stands from 15.2 to 16 hands, and weighs from 1,250 to 1,500 pounds, or even more, the weight varying with the kind of work, wagon, etc., to which a horse is to be put. In some cases a team hitched to an express wagon will be seen showing all the characteristics of the true drafter, but, as a rule, these horses are for heavy dray work, and are not looked upon as representative expressers.

Conformation.—The most pronounced type of expresser is a rather upstanding horse with strong, closely coupled body, considerable width of chest and hips, sound, clean limbs, and particularly sound, healthy feet. Special stress is placed on the health, quality, and conformation of the foot. Excepting the class following (the bussers) no class of draft type has to undergo the same amount of strain on the feet as the expresser. Hauling a loaded wagon at the trot soon tells on any but the best organs of locomotion.

When an expresser is said to be upstanding the inference should not be that he is what could be denominated "leggy." This extreme is to be absolutely avoided, and as between the two, a horse with short legs is much preferable. Buyers demand a sensible medium. The most striking features in the conformation of an expresser are (1) his high finish with considerable weight—"a draft horse with coach finish"—and (2) his rather upstanding appearance as compared with other draft classes.

Action.—His work makes the trot of an expresser his most important gait. It should, above all things, be straight, frictionless, as smooth as possible, and quick and regular. The walk must be similary developed.

Demand.—The express companies constitute the ruling factors in the trade for this class of horses, but other lines of business that require an extra good light delivery horse find in the expresser such an animal as they desire. The lighter teams of the packing companies are heavy expressers, weighing from 1,450 to 1,550 pounds.

Fire companies buy horses very much after this type, getting a somewhat "toppy" animal that shows much intelligence and courage. Police horses come from somewhat similar sources.

ENGLISH TYPES.

Much is heard of English "light vanners" and "parcel carters." These are simply the English forms of what we call expressers, changed somewhat to conform to English requirements—that is, with legs as short as possible. The two names are used for practically the same class of horses.

THE OMNIBUS HORSE.

Size and weight.—A typical busser stands from 15.1 to 15.3 hands, and weighs from 1,200 to 1,400 pounds.

Conformation.—In form he is a compact, rugged little horse with all the characteristics of the true draft type, set on short, strong legs, with ample bone, more or less feather, and sound feet. He should carry a fairly high head and show some style.

Action.—The work of this class is performed almost wholly at the trot, and, accordingly, we will look for a horse that is a "straight line mover"—that is, straight and true in movement. He should have plenty of activity, with a moderately attractive action, but especially with a trot that is quick, straight, elastic, and smooth—a true, frictionless gait.

Demand.—These horses are used in large numbers on the streets of foreign (especially English) cities to draw the omnibuses that are a common means of transportation. Some are employed in the trade of American cities demanding a light, stocky, active horse for miscellaneous purposes. He fills, to some extent, the call for a general-purpose horse, but he should not be confused with the horse quoted as "general purpose" in market reports. The prices that bussers are bringing show not only the strength of the demand but the comparatively small supply.

THE TRAM HORSE.

Trammers are very little different from bussers, except that they are rather plainer, an inch or two smaller in size, and correspondingly lighter, but they should have as much weight as possible for their height. They are used on the tramways of European cities.

ARTILLERY HORSES.

Contracts for horses for the army artillery service often give an outlet for small horses of the draft type weighing from 1,100 to 1,250 pounds. They are not of any particular line of breeding, being often of the blood of the light breeds, but they must fill very exact requirements to be acceptable. Two classes are generally recognized, one for light and the other for heavy artillery. Quite large numbers are purchased for use in the British army, a horse answering the description of a light parcel carter being taken for this purpose.

The specifications herewith given for the United States artillery horse will be seen to be those of an expresser without the weight:

(Article 1142, United States Army Regulations, 1901.)

The artillery horse is required for quick draft purposes, and should move the carriage ordinarily by weight thrown into the collar rather than by muscular exertion.

The animal must be sound, without blemish or defect, well bred, of a kind disposition, and free from vicious habits, a square trotter, well broken to harness and gentle under the saddle, with easy mouth and gait, and with free, prompt action at the walk, trot, and gallop, and otherwise to conform to the following description:

A gelding of uniform and hardy color, in good condition, from 15½ to 16 hands high; weight of the lead horse not less than 1,050 pounds and that of the wheel horse not more than 1,200 pounds; from 5 to 8 years old, head and ears small, forehead broad, eyes, large and prominent, vision perfect in every respect; chest full, broad, and deep; fore legs straight and standing well under; shoulders sufficiently broad to support the collar, but not too heavy; barrel large and increasing from girth toward flank; withers elevated; back short and straight, with broad, deep loins, short coupled with solid hind quarters; hocks well bent and under the horse; pasterns slanting, and feet sound and in good order. Long-legged, loose-jointed, long-bodied, and narrow-chested horses, as well as those which are restive, vicious, or too free in harness, or which do not, upon rigid inspection, meet the above requirements in every respect will be rejected.

HORSES FOR HARNESS AND SADDLE.

In taking up the class which, excluding cavalry horses, might be termed "pleasure horses," in contrast with the previous group, the classes which are used almost exclusively for business purposes, we come to the horse that brings by far the highest market prices when of a high degree of excellence, but whose breeding has been attended with more disastrous failures than any other; the horse that is the ennoblement of every equine virtue when it approaches perfection and that is the embodiment of uselessness and insignificance when poor. More "tinkering" has been done with trotting, coach, and

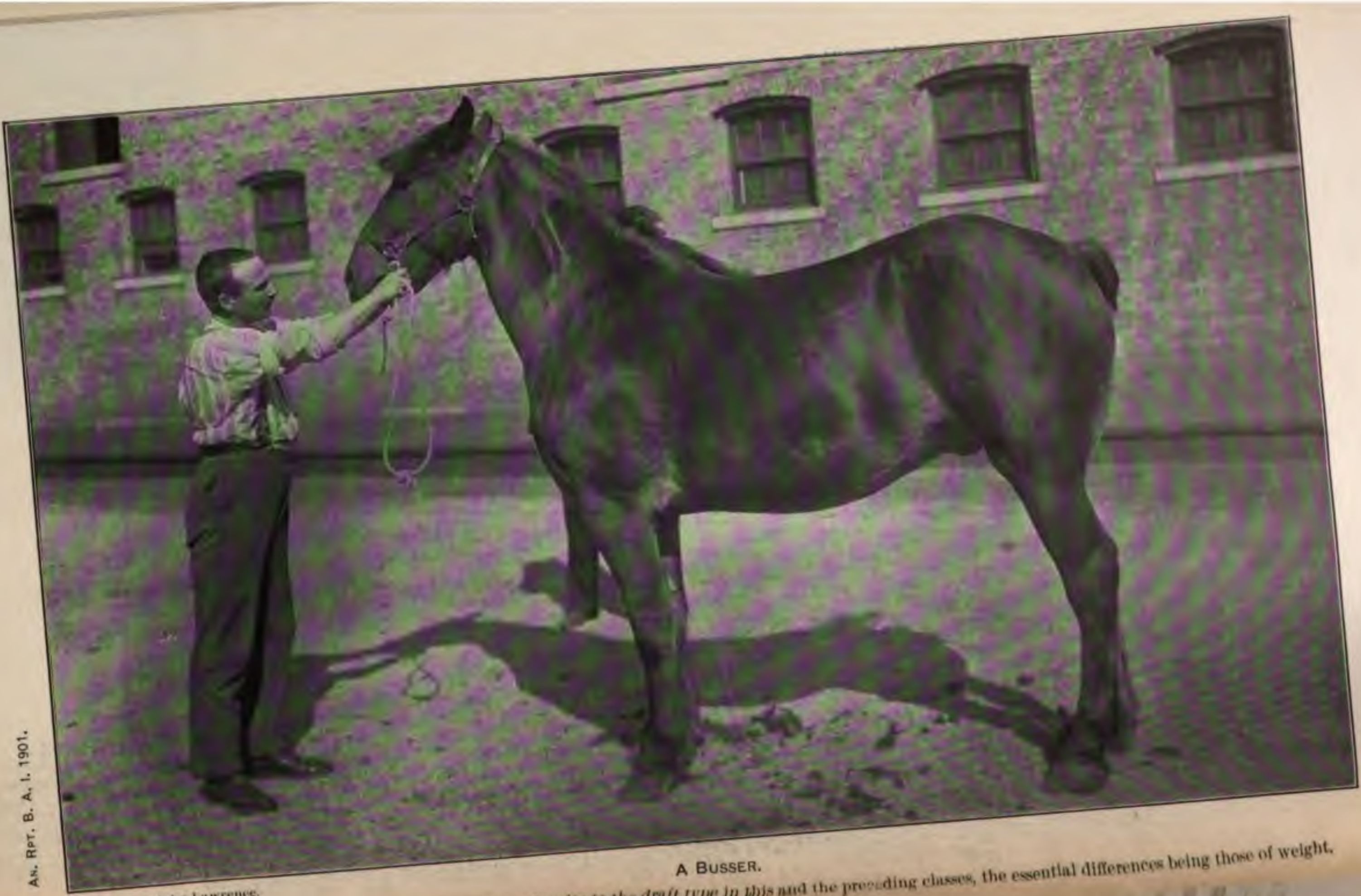
Thoroughbred blood than with any other, and it is safe to state that the unintelligent, indiscriminate, and improper use of sires of these light breeds has had more to do with the development of an unsightly mass of scrub horse stock than any other cause.

Stand by the auction ring of any great horse market and observe closely the horses that fail to bring prices sufficient to cover cost of production. In the great majority of cases trotting blood predominates if any breeding at all is noticeable. Ask a dealer what is the breeding, if any, of most of the large numbers of the unclassified horses on the market, his answer will be: "Trotting and coach blood." This is not because draft blood is more valuable or that the blood of the light breeds is not wanted, for the great cry of the market at present is that good drivers and saddlers are extremely scarce. It is because performance and style are much more difficult to acquire in breeding than size and weight. It is because men with a fascination for the race track attempt to produce trotters without the slightest regard for nature's laws, and no disappointment or failure seems sufficient to bring them to realize their folly. Breeding to a trotter without system and study, but only in the hope of getting a speedy foal as a possibility or an accident, is "playing with fire." The breeding of light horses requires not only a considerable amount of capital, but demands a knowledge of horses of the very highest order. It necessitates concentration of effort and years of waiting and planning. It is not every man that brings such qualities to bear when he takes a 1,600-pound draft mare to a 1,200-pound harness or saddle stallion, and it is largely because of this, and not on account of the breeds themselves, that so many poor horses are forced on the market.

A high-class roadster, coacher, or saddler is by far the most difficult horse to produce that the market calls for. In addition to careful plans of breeding and high individual excellence in the resulting progeny, a course of handling, mannering, and training must be pursued before the horse will figure as a really marketable animal.

These facts must be thoroughly understood if a man would breed light horses for market.

Three pretty well-defined classes, each with several subclasses of more or less distinct demarcation, make up this type. Speaking of the group as a whole, we find that all the virtues of which a horse is possessed must be found in this animal. The higher grades must be perfectly sound in wind and limb, free from blemishes of any kind, and extremely stylish in appearance. Disposition and education are very important; the uses for which he is intended and the conditions surrounding him require that he be kind, gentle, cool-headed in emergencies, and well mannered, yet full of spirit and energy.



Photograph by Lawrence.

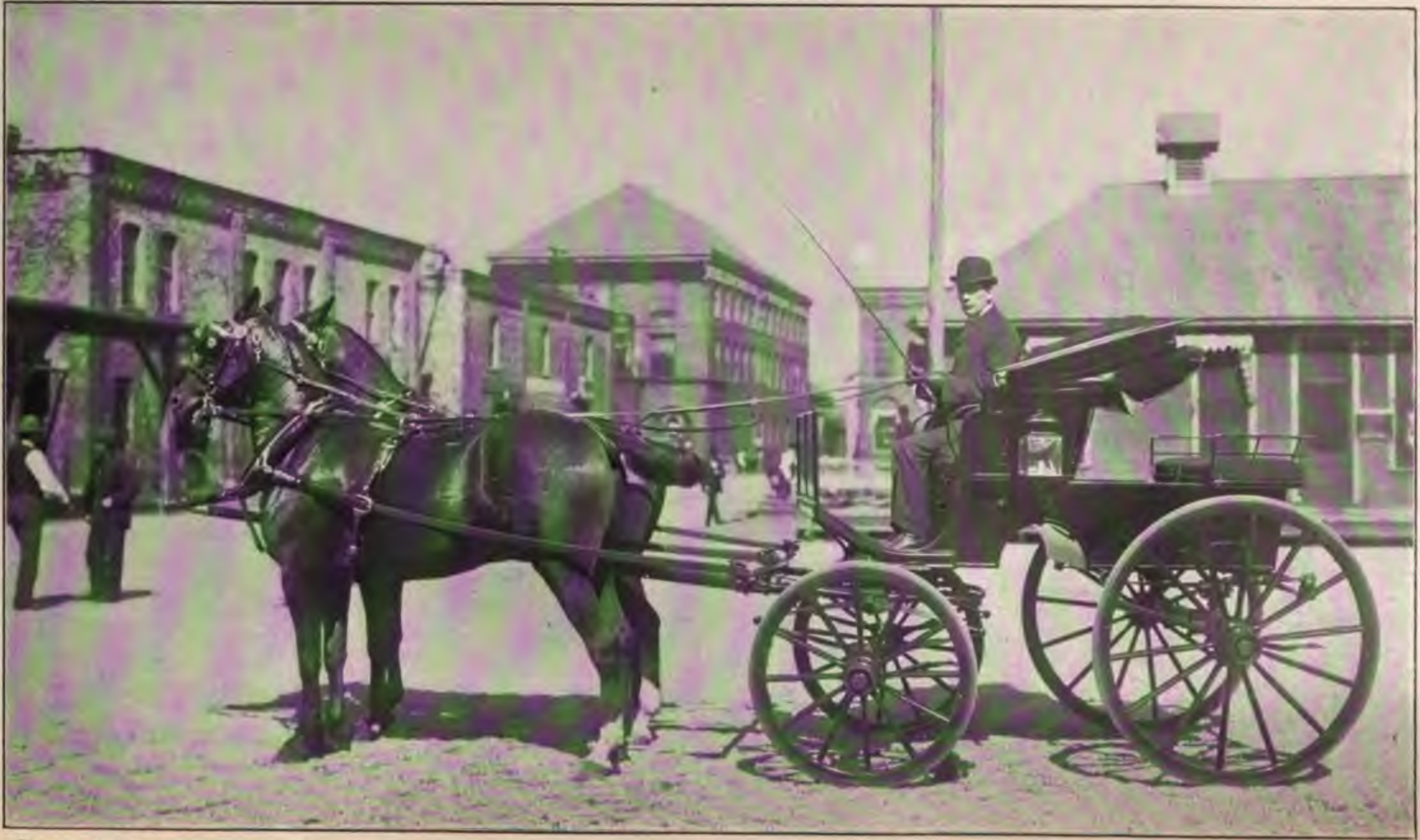
A BUSSER.

the close conformity to the draft type in this and the preceding classes, the essential differences being those of weight.

ROADSTERS.

By courtesy of Rider and Driver.

Photograph by Lawrence.



Photograph by Lawrence.

A PAIR OF

DRIVERS.

Roadsters.

Size and weight.—The typical roadster stands from 15.1 to 15.3 hands high and weighs from 950 to 1,150 pounds.

Conformation.—We note now a very radical difference from the heavy horse. The roadster is more upstanding, not so wide, and entirely lacks the massiveness of the drafter, but is deep of chest and middle. In extremes of roadster form, especially when in racing condition, there is a prominent appearance of angularity that, though not unpleasing, is a sharp contrast both to the form of the drafter and, as will be shown later, to that of the coacher.

It is highly essential that feet and legs be not only sound, but of that correct conformation that will prevent unsoundness to the greatest possible extent. The pasterns should be sloping and strong, and the shoulder deep and sloping and extending well into the back. The withers are high and sharp, the back strongly muscled, short, and closely coupled, and the hind quarters long and heavily muscled. The bones from elbow point to knee (forearm) and from stifle to hock (leg) should be nearly twice as long as the cannon bones in their respective limbs, thus giving long leverage and muscles that are long, and therefore quick to respond, and placing the fulcrums of these levers close to the ground, giving strength, steadiness, and poise. The neck should be of medium length[a] to long, smoothly joined to the shoulder, and clearly defined, with a clean-cut throatlatch. The head should be fine and clean-cut, with an erect, neat, medium-sized ear, a full, clear eye, and full, good-sized nostrils. Stamina is an essential of this class, and, as an indication, a high degree of quality will be looked for.

Action.—There are two opinions prevalent in the market regarding the trotting action of a roadster. One places more emphasis on its approach to the extremes of coach action, while the other regards moderately high action as essential, but does not carry it to the point where speed is sacrificed. This latter idea carried out will develop the long, reachy action that tends to increased speed; it will develop class of horses that will closely approach the true trotter and will at the same time be less wearing on the horse. The former will branch off in an entirely different direction, with the coach horse as its ultimate end, and, if much speed is also present, will entail a severe strain on the horse. In other words, as between action and speed in a roadster at the trot, some will place more importance on action, while others will seek to develop speed, and will buy accordingly. As a roadster, strictly speaking, is a horse whose purpose is to draw a light rig on the road at a fairly high rate of speed for a considerable length of time, the latter idea is technically more nearly correct. All-around and not extreme action is desired. It must be prompt, straight, and frictionless, whether at the trot, the pace, or the walk.

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[a] It is questioned by good judges and expert buyers whether it is possible to get a neck too long in a horse of any class.

Demand.—Roadsters are in demand for city or country use, and for any purpose where a horse is wanted for fast driving to a light road wagon or run-about.

The Standard-bred horse.

Size and weight.—The Standard-bred trotter or pacer is the horse of the foregoing class more highly specialized and always eligible to registry in the trotting register.

Conformation.—This shows the extreme of speed production, and is the result of years of breeding for the sole purpose of increased speed. It is the roadster type carried to the furthest known limit. A better description of the type was never made than the one comparing the conformation to that of the greyhound.

Action.—The sole purpose of action in the Standard-bred horse is for the development of the greatest speed with the least possible expenditure of energy. The most important essentials are straightness, smoothness, and reach.

Demand.—Eligible trotters and pacers are in demand for racing purposes, both amateur and professional, and for the breeding stud.

COACHERS.

The connection between the coach horse and the roadster is extremely close, the differences between the two groups being chiefly those of conformation and action.

Coach horses.

Size and weight.—A typical coach horse stands 15.2 to 16 hands and weighs from 1,100 to 1,250 pounds.

Conformation.—A coacher is considerably heavier, smoother, and more compact than a roadster. The conditions of his work, of course, require soundness as an absolute essential. His legs are clean cut and well muscled, with sloping pasterns and shoulders; the back short, closely coupled to the hind quarters, and smoothly muscled. The hind quarters are well packed with muscle, smooth, and rounded, not straight and angular as in the roadster. A smooth, well-filled, evenly rounded quarter is regarded with much favor. The tail should be set well up and carried high. In the shoulders the same points of smoothness and lack of angularity are required. The withers should be high and thin, the neck smoothly joined to the shoulders, long and clean, with a full crest, the head fine and of medium size, with fine ears, a full, clear eye, and large open nostrils.

Quality is as important in the coacher as in the roadster, and for similar reasons.

Action.—Conformation and action are absolutely essential to a coach horse and to each other; that is, a horse can not lay claim to merit as a coacher unless he has both of these qualifications. Proper conformation should first be present, for then the animal may be trained to act fairly well, but if a fine actor is rough and "weedy" in make-up no amount of feeding and care can give him form and style.

In discussing the coach action the necessity for the legs to be moved straight and true is perhaps the first thing to be considered, for the extreme flexing of the legs, especially at the knees, makes it all the more difficult for the horse to move them in a straight line, and thus increases the danger of injury to himself by interfering, to say nothing of the unsightliness of faulty action. The fore legs are flexed as high as possible and the feet extended with a sort of rotary motion that is very different from the long reach of the roadster.

The most difficult action to acquire is at the hocks. That of the knees may be developed by training and shoeing, but high, elastic hock action is well nigh a hopeless proposition unless bred in the horse. It may be easily inferred that it is far less common than first-rate knee action. The hocks should be flexed without any deviation from a straight line, the feet carried in much the same manner as in front and placed directly in front of their former positions, with as little jar as possible. At all times a coacher must "keep his legs under him." He does not extend himself as a roadster; there is not the long reach in front nor the swing behind.

A moderate degree of speed always gives added value to a coach horse, but much speed is not only not absolutely necessary, but is, according to the nature of things, usually out of the question. Much of the energy of the horse's effort is expended in lifting his feet as high as possible, and the combination of this effort with that of speed-making reach is asking too much of a horse, as it entails so great an amount of wear on the animal organism that it would soon give way.

While a coacher must be thoroughly sound, he is not required to have the great speed powers or endurance of the roadster. Short distances only are expected of him at a rate of from 6 to 10 miles an hour.

Demand.—The demand for a stylish animal for city driving takes all the available horses that come to the market. Some are exported, but the foreign demand has comparatively little effect on this class. The demand from the American cities is strong, the only complaint being that the right kind of horses are extremely difficult to find.

Cobs.

Size and weight.—A typical cob stands about 15.1 hands and weighs from 1,000 to 1,050 pounds.

Conformation.—If anything, the cob is more compact and smoother than a coacher, and on somewhat shorter legs. He shows the highest

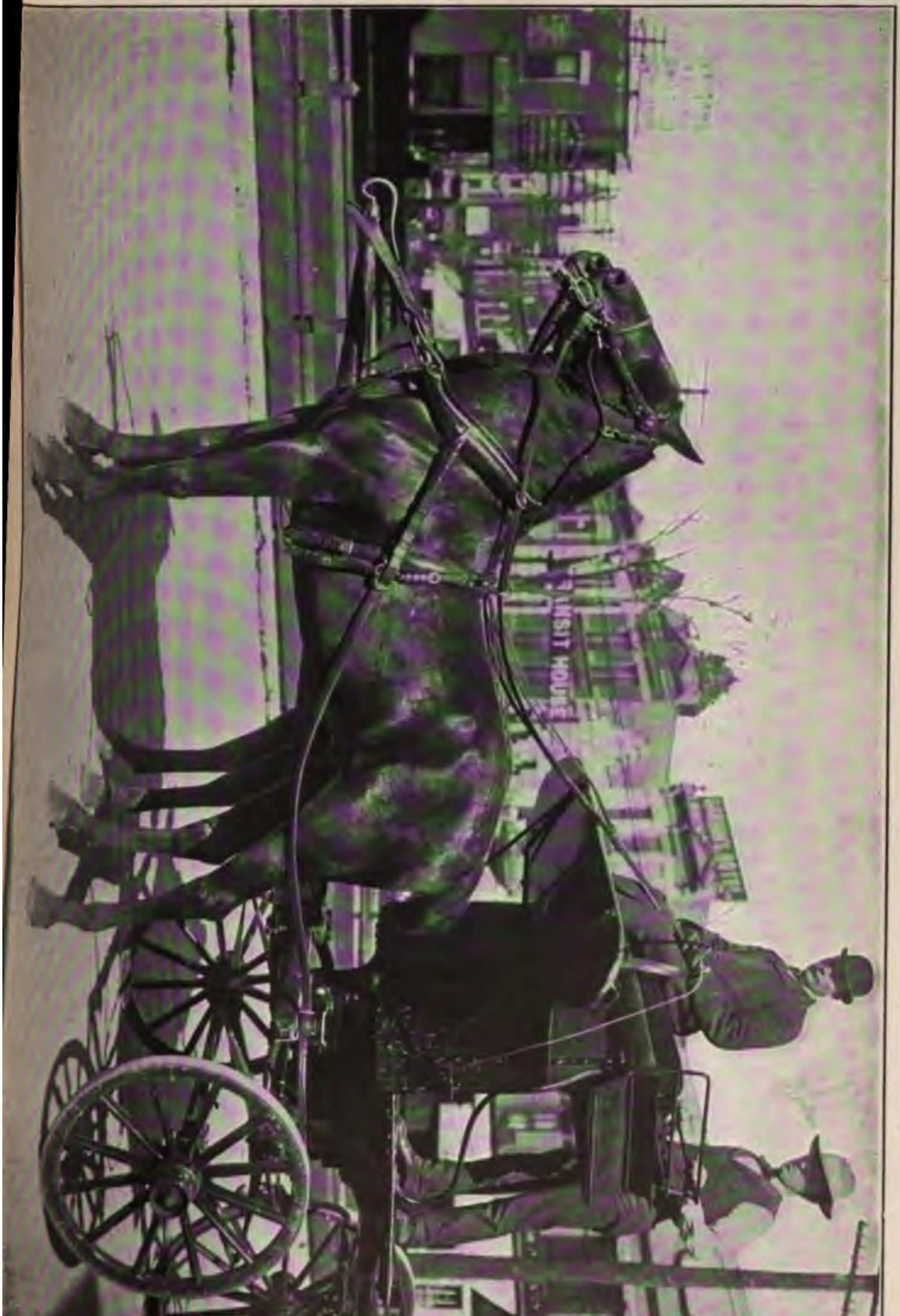
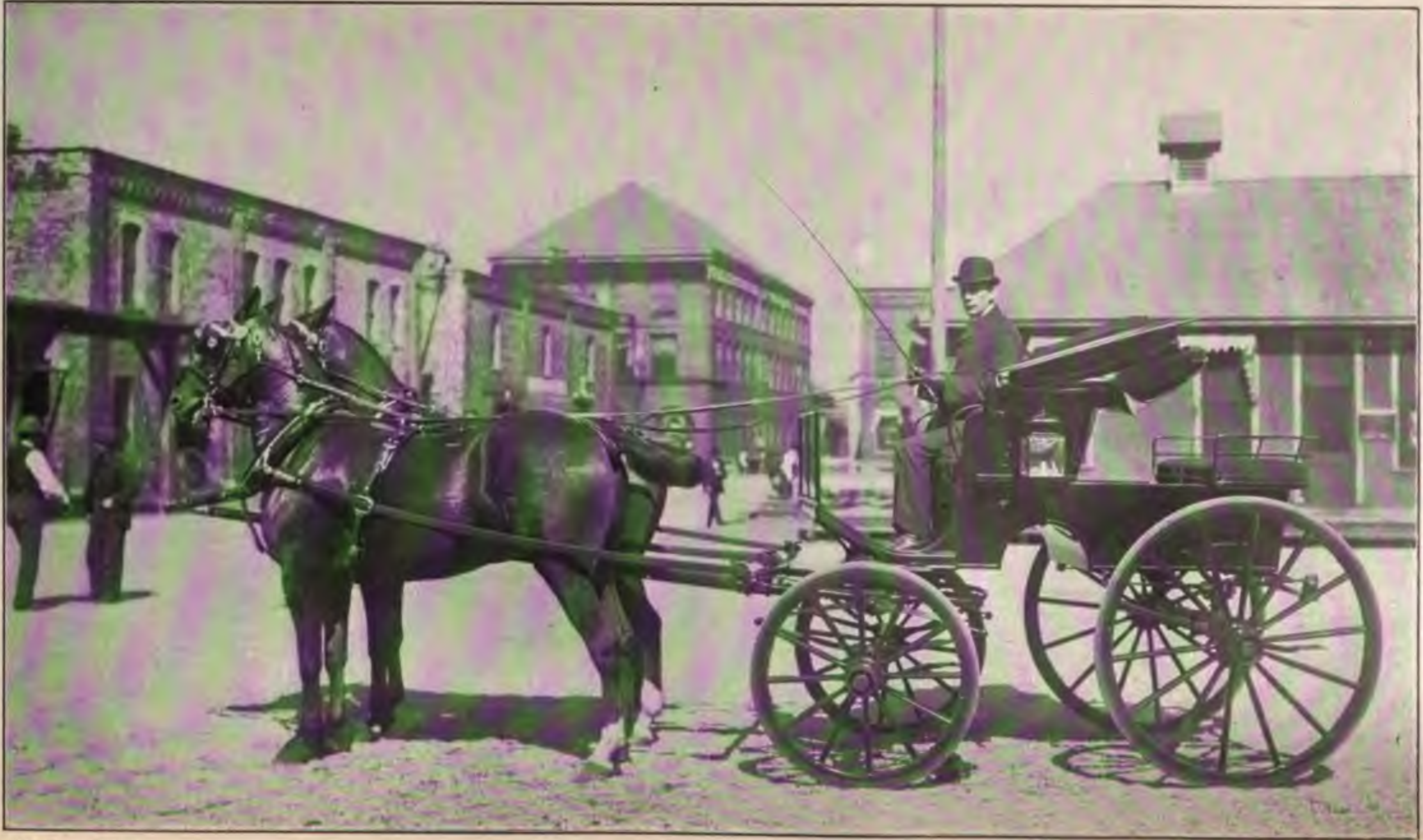

ANSIT HOUSE

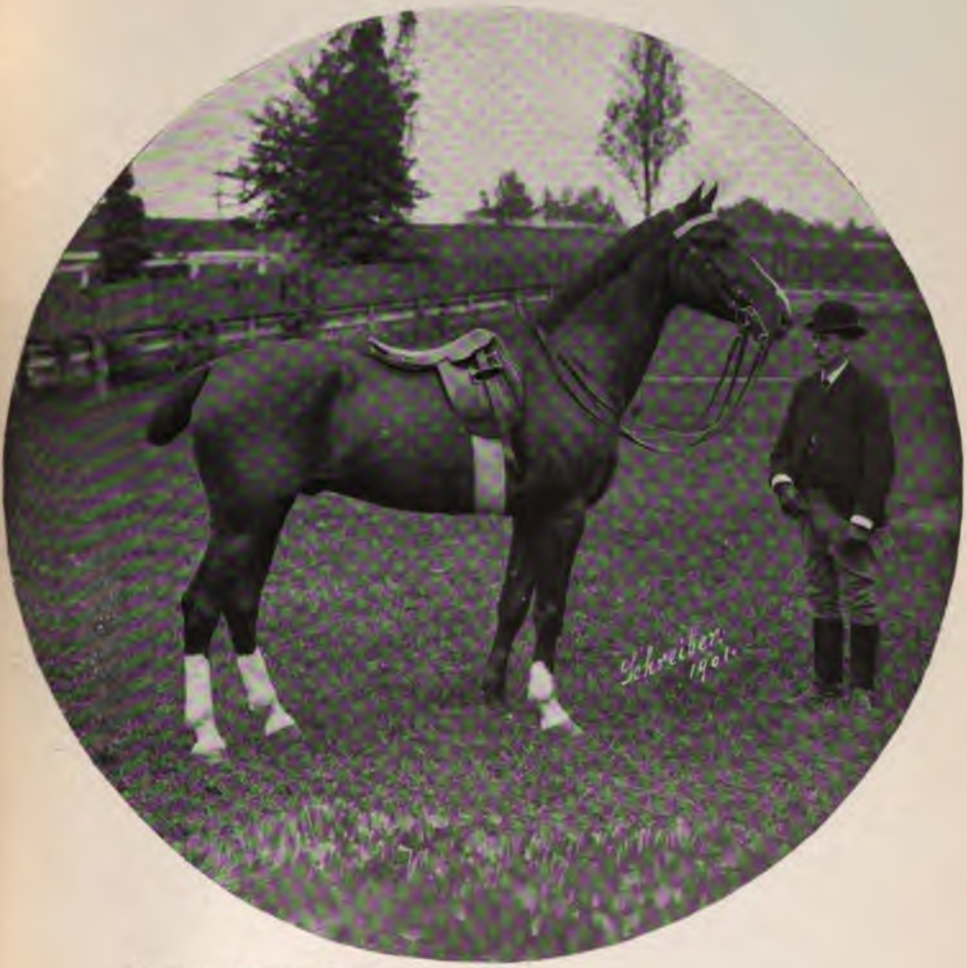
Plate LXX.



Photograph by Lawrence.

A Pair of Ladies' Cobs.

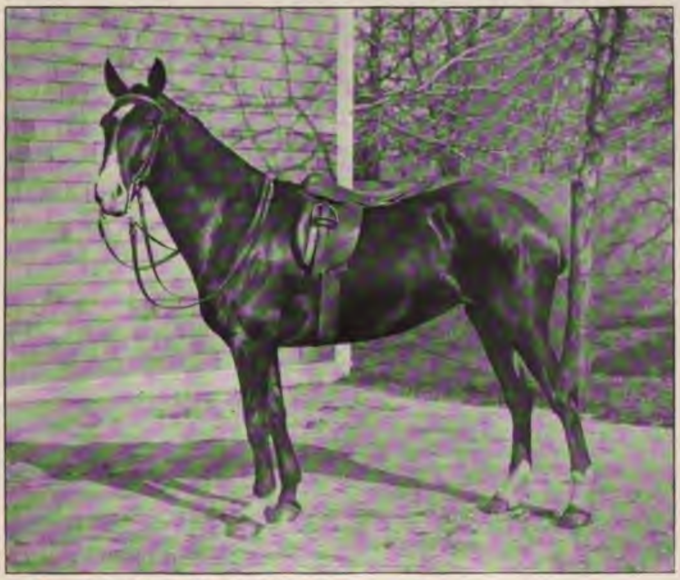
Note the style, symmetry, and high quality, and, in comparison with the foregoing pair, the smaller size and lighter, finer bone.



By courtesy of Rider and Driver.

A TYPICAL HUNTER.

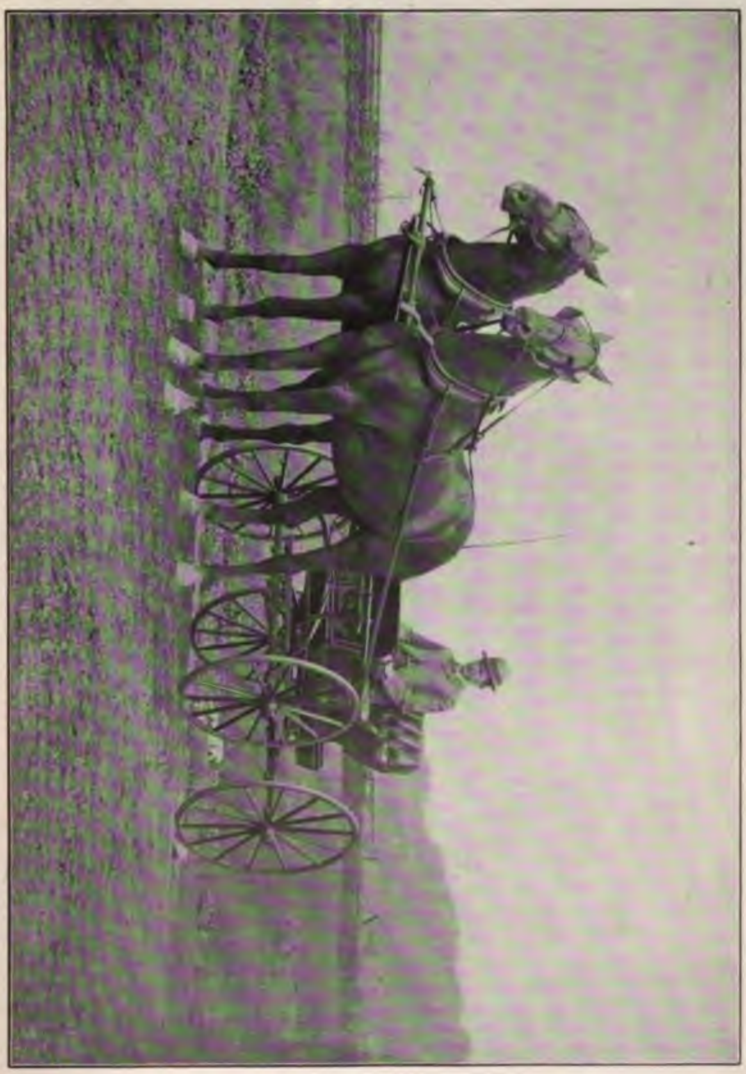
Observe the rangy conformation, and abundance of muscle and bone that are characteristic of this class of horses.



By courtesy of Horse Show Monthly.

A GOOD TYPE OF POLO PONY.

This pony was western bred.



A PAIR OF RANGE-BRED COACHERS.

Photograph by Thompeter.

is acceptable to breeders of this type, but the first four must always be present. The dictates of fashion have a good deal to do with the market demands for gaits. Just at present a horse with walk, trot, and canter only is somewhat preferred, but the American saddle horse will always be in demand as a very useful animal, and will be valuable in the production of saddlers, for training can bring out the desired action, and for intelligence and extreme style no breed will surpass him. Saddle action must, first of all, be sure. A horse inclined to stumble is dangerous. Following this we look for snap, moderate height, and particularly straightness and evenness in all gaits.

Demand.—Saddlers are in demand for both city and country trade, and are by no means equal to the demand.

Hunters.

Size and weight.—The class of horses known as hunters is divided into "light" and "heavy" hunters; the former carrying ladies and light-weight men, and the latter able to take men of a weight up to 200 pounds. Naturally there will be many variations between these two classes, the requirements of each rider indicating the weight of his mount. A range of from 15.2 hands, with a weight of 1,100 pounds, to 16.2 hands, weighing 1,200 or 1,250 pounds, would be a fair approximation.

Conformation.—A typical hunter shows a conformation of a rather rangy order, but not loosely built, standing pretty well from the ground with legs of much bone, depending on the weight he is to carry, and with the knees and hocks as close to the ground as possible. The shoulder should be deep; the body deep and full chested; "short above and long below," the barrel with a good development, but not paunchy—well built in every particular to be a ground gainer. Too much muscularity can hardly be present; the hind quarters should be especially long and deeply muscled. Thick necks are avoided; rather a thin long neck with a good-sized intelligent head is preferred.

The hunter must show plenty of quality; stamina is absolutely necessary for work such as he is to perform. His head must show that high degree of intelligence and fearlessness that insure the confidence of his rider.

Action.—The most desirable feature in the motive power of a hunter is his jumping ability. Not only must there be the capacity to clear any reasonable obstacle that presents itself,[a] but this must be done gracefully and willingly. Of course, a straight, smooth, easy movement is always necessary. Speed adds much to the value of a hunter, especially if his rider has ambitions to gratify.

Demand.—This class of horses is in ready demand by persons of means who enjoy the sport of following the hounds. The same condition presents itself that is found in other classes of light horses, namely, that the price of a suitable animal will always be a long one. Riding to hounds is gaining in popularity in this country and is an influential force in the development of the horse market.

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[a] The usual height of the fences hunted over ranges from 3 to 4 feet.

Thoroughbreds.

The breeding of Thoroughbreds is rapidly assuming large proportions. Many of the sales that have been held during the past year have averaged $1,000, even for yearlings, and fabulous sums have been paid for mature breeding animals, the large prices brought by aged mares showing the strong demand that exists. The Thoroughbred bears to some extent the same relation to the hunter that the Standard-bred horse does to the roadster; that is, he is largely the producer of the hunter, the principal difference being that the hunter usually lacks the speed of a racer, and is not recorded in the studbook.

Polo ponies.

The three essentials of a polo pony are (1) weight-carrying ability, with small size, (2) agility, and (3) speed.

Size and weight.—The maximum weight is 14.2 hands. The weight for such a height would be about 850 pounds.

Conformation.—Good bone and compact conformation are requisite. with as much muscle as possible. "Get quarters on him like a cart horse, if you can," said a polo authority. Short cannon bones, especially in the hind legs, give the horse a control of himself that enables him to turn with speed and agility. Perfect soundness and extreme quality are indispensable, for the strain of the game and the demands made on a pony's endurance are always severe.

Intelligence and training.—Courage and intelligence are prime requisites with a polo pony. Quickness of sight and a keen enjoyment of the game make an animal still more valuable. Along this line it must be remembered that all ponies will not learn the game. Horses are differently constituted in this respect, and such things must be expected.

Action.—The principal requirement in action is agility. The pony must always have himself well under control, with the ability to come to a dead stop almost instantly from a run, and a quickness that enables him to "turn on a dollar," as a Westerner puts it. Speed is also necessary, but agility first of all.

Demand.—Like the preceding class, the growth of a fascinating sport is rapidly opening up a market for another class of horses, and, like the hunters, polo ponies bring long prices when suitable for such work, and are sound. Most players have four or five horses constantly on hand, and some have twenty or thirty in their stables.

It is an interesting fact that no better polo ponies are found in the

United States than Western "cow ponies" that are sound and well set up, with a few months' education in the rudiments of the game as a finishing school.

Cavalry horses.

Troopers.—At uncertain intervals the market calls for horses to fill contracts with army authorities. The demand is not exceedingly large at any time and at no time is it steady. As a general rule, these horses are selected from the various classes of light horses. Foreign governments have executed orders to some extent for army stock, most horses that are regularly bought for this purpose going to England; and within the past two years immense numbers of animals have been purchased by British agents for use in South Africa, swelling the exports last year by over 30,000. Under no circumstances, however, can the army demand be looked upon as of such character as to affect the market steadily.

The best horses bought for army purposes in this country are for the United States Army, those bought for home use by the British army next, and the stock for South Africa fall to the bottom of the scale. The United States Army demands a practically sound and unblemished horse. The specifications for the cavalry horse follow:

(Article 1142, United States Army Regulations, 1901.)

The cavalry horse must be sound and well bred; gentle under the saddle; free from vicious habits; with free and prompt action at the walk, trot, and gallop; without blemish or defect; of a kind disposition; with easy mouth and gait, and otherwise to conform to the following description:

A gelding of uniform and hardy color; in good condition; from 15¼ to 16 hands high; weight not less than 950 nor more than 1,150 pounds; from four to eight years old; head and ears small; forehead broad; eyes large and prominent; vision perfect in every respect; shoulders long and sloping well back; chest full, broad, and deep; fore legs straight and standing well under; barrel large and increasing from girth toward flank; withers elevated; back short and straight; loins and haunches broad and muscular; hocks well bent and under the horse; pasterns slanting, and feet small and sound.

Each horse will be subjected to a rigid inspection, and any animal that does not meet the above requirements in every respect must be rejected.

A horse under five years old should not be accepted unless a specially fine, well-developed animal.

MINOR CLASSES.

Strictly speaking, the horses mentioned below are not in market demand. They sell, however, if the price is low enough, and follow the natural result of such a condition of being dangerously near a losing investment to the seller.

GENERAL-PURPOSE HORSES.

A very large proportion of the horses on the market are what are known in stock-yards reports and market quotations as "general-purpose" animals. They are horses without any particular type, embracing misfits of all kinds of breeding, though not scrubs, as a rule, and usually being of fair to good quality without those characteristics that fit a horse for a market class. In many cases they may be serviceably sound—perhaps so in the majority of instances.

Such animals are used, as the name designates, for anything and everything, but the demand is not well defined, and the supply far too large to make this kind of horse a feature of the market other than by its numbers. The average prices for them are next to the lowest quoted.

SOUTHERN HORSES.

At most of the Western markets, particularly those on the Missouri River and at St. Louis, there exists a good demand, strongest in the spring of the year, for a rather inferior grade of horses for the Southern trade. They range in quality from very inferior to very "nice" animals. They comprise mainly an assortment of practically unclassed horses, but as much of the roadster type as any. Many are sold as drivers, some as saddlers, the best grades usually going to Virginia. Prices range from $5 to $200.

PLUGS AND SCRUBS.

These wrecks of horseflesh seem out of place in a discussion of market classes of horses. Plugs are usually those animals that have come back from final sale after being worn out by long years of work. Scrubs are described by the name.

THE MARKET FOR RANGE HORSES.

This phase of the horse market is somewhat difficult to treat. When animals are sold on the market as "range horses," it is generally understood that they are unbroken branded horses brought in and sold in carload lots, usually going to the country to be broken, and finally resold as finished horses. On the other hand, if range men are equipped to break their young stock thoroughly and do not brand them, such horses sell as natives, and strictly on their merits.

While the prejudice against a branded horse is not so strong as formerly, a brand still has a very cooling effect on the enthusiasm of a prospective buyer. The memory of the evil disposition of the old horse of this country and the frequently exaggerated stories of its presence to-day are constantly called to the attention of the public. However, it is safe to state that the character and disposition of the range horse and his individuality are being greatly improved by the enlightened policy of the more progressive ranchmen. His temper is being bettered by closer communication with man and better methods of handling, and the standard of breeding is being raised by the use of large numbers of purebred sires that have been brought in from the Eastern States and Europe. At the same time the wonderful quality and endurance of the native stock have been retained, and, however we may look upon the range horse personally, we must admit that the foundation is there for a very excellent horse stock. The systematic experimenting that has been done by shipping rangers East as youngsters has been very successful, though grades of only average quality were used.

In speaking favorably of the range horse, the grades which are usually the offspring of purebred sires are meant. These represent what the range is able to do in producing horses, and show its possibilities in the best light, which is no more than fair. With the average old-time ranger—the cayuse, mustang, or Indian pony—only exceptional individuals are worthy of attention. In the main, there is no meaner kind of equine to be found than what is known in different localities under one or another of these names.

It can not be said that even a large part of the range horses sold on the Western markets show much evidence of breeding. The work of improvement is yet in its primary stages.

The rangers divide into three fairly well-defined classes—ponies, saddlers and drivers, and chunks.

PONIES.

These are the descendants of the ancient stock that is known by the various names of cayuse, Indian pony, mustang, etc. They stand up to 14.2 hands, weighing up to 750 or 900 pounds. Some of them are horses of quality, endurance, and intelligence, and make good riding animals.

These horses are very useful for herding cattle, often showing an intelligence that is wonderful and an agility that is frequently disconcerting to the rider. They also furnish some of the best material for polo work that can be found, especially when mares of good type are crossed with small Thoroughbred sires. However, the cow pony that will make a good polo pony is not easily found. It is the exception, not the rule, that satisfies the buyer and brings the long prices. In such instances, the pony would not go on the market under the same conditions as the ordinary ranger. He is the exception, but an exception that serves a valuable purpose for illustrating the possibilities of the best types of range stock.

SADDLERS AND DRIVERS.

These horses are the first as a range class that may show breeding. The grades of coach, Standard-bred, and Thoroughbred sires will come under this head. They could be described as horses standing from 14.2 to 15.2 hands and weighing from 900 to 1,100 pounds, with an occasional good one of larger size.

CHUNKS.

These usually embrace the draft grades, standing 15 hands and up, and weighing from 1,100 to 1,400 pounds. Extra individuals often weigh over 1,500 pounds.

DEMAND.

The larger number of range horses normally find their final place of consumption on farms and in small towns. The British Government has bought thousands of them, and the United States Army is often supplied with cavalry horses from these sources. Quite often branded horses will be found in the export stables.

THE ANGORA GOAT INDUSTRY.

PROGRESS OF THE ANGORA GOAT INDUSTRY IN 1901.

By George Fayette Thompson,
Editorial Clerk, Bureau of Animal Industry.

PRELIMINARY REMARKS.

A wonderful interest has been manifested during the year 1901 in the Angora goat industry, and many of the large flocks of the Southwest have been divided up and distributed throughout the United States to such an extent as to become a matter of astonishment. Angora goats can probably be found at this time in every State of the Union; and they have become a familiar sight in hundreds of localities where absolutely nothing was known about them a few years ago. This is the result of the wide dissemination of information concerning these goats by the Bureau of Animal Industry and by the press.

The census of 1900 for the first time took an account of the goats in the United States. Early in 1901 the Census Office issued a statement that the number of common goats in and around cities was 47,652, and it was generally believed that this represented practically the whole number in the United States. He was so small a factor before the public that the present writer said[a] a year ago: "So far as the general public is concerned, he [the common goat] has not been reckoned with as a useful animal and has been tolerated only as a pet for children." More recent information has been brought to light by a census report which shows how erroneous an estimate may be in the absence of accurate figures for a basis of such estimate.

The number of goats of all breeds reported by the census for 1900 is a matter of great surprise. They had not figured in the markets as meat; their skins were hardly mentioned as a product for our leather goods manufacturers; any number actually kept for milk were seldom heard of; and, although common goats will eat brushwood as greedily as Angoras, their use for this purpose has never been noted. Notwithstanding these facts, there are reported for the United States a total number of 1,871,252 goats of all kinds on farms, and 47,652 in cities and towns, making a grand total of 1,918,904 in the United States.

The following statistics (page 458) from the census of 1900 show the number and value of goats and the number of farms upon which they were found.

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[a] Bul. No. 27, Bu. An. Ind., p. 9.

Number and value of goats, all breeds, in the United States in 1900.

State or Territory.	Number of farms reporting.	Number.	Value.
Alabama	8,633	117,413	$94,258
Alaska	----------	----------	----------
Arizona	436	98,403	167,863
Arkansas	4,571	51,839	58,788
California	1,579	109,021	262,981
Colorado	620	37,433	73,141
Connecticut	73	313	1,945
Delaware	43	143	519
District of Columbia	6	9	39
Florida	2,154	43,705	32,639
Georgia	6,716	84,624	61,972
Hawaii	19	653	731
Idaho	68	4,481	20,167
Illinois	1,642	8,877	19,932
Indiana	1,518	4,484	8,920
Indian Territory	733	10,529	21,538
Iowa	3,007	41,468	146,708
Kansas	995	18,288	71,290
Kentucky	2,144	11,967	19,753
Louisiana	2,723	38,308	35,697
Maine	70	279	1,091
Maryland	227	1,179	4,023
Massachusetts	145	1,254	7,188
Michigan	537	2,861	10,008
Minnesota	498	3,821	12,908
Mississippi	5,431	55,388	45,594
Missouri	2,754	24,487	64,786
Montana	61	1,713	7,870
Nebraska	488	2,399	9,126
Nevada	39	4,633	12,948
New Hampshire	61	208	916
New Jersey	200	699	3,006
New Mexico	2,874	224,136	472,961
New York	576	1,316	6,442
North Carolina	5,089	42,901	37,997
North Dakota	142	1,122	5,308
Ohio	1,025	5,432	16,975
Oklahoma	277	3,772	10,854
Oregon	2,178	109,661	375,229
Pennsylvania	763	2,197	8,951
Rhode Island	16	23	131
South Carolina	3,643	26,576	24,450
South Dakota	252	2,915	15,050
Tennessee	3,663	25,884	38,938
Texas	6,742	627,333	923,777
Utah	93	1,427	2,702
Vermont	41	102	444
Virginia	1,004	5,305	10,002
Washington	165	2,876	10,757
West Virginia	219	847	2,123
Wisconsin	534	3,882	12,760
Wyoming	47	2,666	11,884
Total	77,534	1,871,252	3,266,080

The total should be increased by the 47,652 in cities. The result would then stand 1,918,904 for the whole country. Further developments are necessary before a statement can be made of the uses of so large a number of common goats, for there can be no doubt that more than 1,000,000 of this number are of the common breed.

The schedules sent out by the Census Office contemplated a separate statement for Angora goats, but so little attention was paid to the request by the enumerators that it was found impossible even to approximate the number of Angora goats in the United States. This is a matter of great regret to the Angora goat raisers of the country, for they have confidently expected that the census report would show exactly the number of these goats in the country.

CAUSE OF THE SPREAD.

AS BRUSH DESTROYERS.

Some parties have gone into the industry primarily for the production of mohair, but a much larger number have purchased the goats for the main purpose of clearing up brushwood. The Angoras, however, have been preferred for clearing brushwood on account of the additional profit which they give over any other breed. They will do their work thoroughly and at the same time produce a fleece which is valuable in proportion to the quality of the animal. If they die or are slaughtered, the pelt may be converted into a rug or robe, worth from $2 to $7, while the best skin of a common goat would bring about 80 cents. Their flesh is considered equal to mutton, and it has not been a difficult matter to find a ready sale for it wherever it has been tested.

Within the last year many flocks of Angoras of moderate size have been taken into the "stumpage" districts of Winconsin and Michigan; that is, into sections where the timber has been cut off for lumber and a dense undergrowth of brush has followed. There are in those States thousands of acres of such land which are utterly worthless so long as it is brush ridden, and much of it is not valuable enough to make it profitable to clear it off by hand labor. Here the goats can best show their ability, and they are of little or no expense for feed so long as the snow does not prevent browsing.

Some of the clearing of brushwood in Michigan is shown in Plate LXXVI. This view is on the farm of H. B. Fuller, at Lewiston, who says this about it:

> The photograph represents less than a month's work of the goats. The goats were placed in th s lot, or large corral, the first two days here and after that were confined there at night only. They were poor when received and had a hard trip. They ate the brush greedily. Not a brush has been cut or a stick removed where the photograph was taken. Their general work has also been most satisfactory, and they have grown fat, and now have a nice length of mohair. If they winter as easily as I think they will, they will be a most valuable animal for this section and will much more than meet my expectations.

No less striking is the work done by goats on the farm of George H. Baldwin, at Mendon, Ill., which is shown by photographs reproduced here as Plates LXXVII and LXXVIII. Mr. Baldwin writes as follows under date of January 13, 1902:

> No. 1 [Pl. LXXVII] was taken in a pasture where goats had browsed for nearly two years. When the goats were turned in the sprouts on the stumps were from one to four years' growth. Nearly everything that the goats could reach by standing on their hind feet or bend down has been killed, except hickory; this they do not eat if they can get anything else. No. 2 [Pl. LXXVIII] is an adjoining pasture, where the goats have recently been turned in and the sprouts not yet destroyed.

The brushwood upon these two views was originally of the same character. The pastures are separated by a public highway only.

An excellent contrast between a pasture where goats have worked and one where they have not been is shown in Plate LXXIX. A woven-wire fence separates the two tracts. Iowa has many thousands of acres of very rich land which are now covered with brushwood; but the thousands of acres there which have been successfully cleared by the employment of goats are a forceful demonstration of the value of these animals for this purpose. The result is that Iowa now has a larger number of Angora goats than any other central State; and more are constantly being added to those already there.

Mr. J. A. Moberley, of Windsor, Ill., recently informed the writer of this article that he was receiving $150 per month for pasturing cattle on land which, before it was cleared of brush by goats, would not produce enough to pay the taxes upon it. Col. J. Murray Hoag, of Maquoketa, Iowa, also informed this writer that the third year after goats had cleared a tract of 320 acres for him, he pastured upon it 150 steers which took the first premium at the county fair for grass-fed steers; and goats were in the pasture with the steers.

Dr. J. R. Standley, of Platteville, Iowa, who is now the inspector-general for the American Angora Goat Breeders' Association, is the gentleman who discovered the practicability of employing these goats for destroying brush. Views showing the work of Angora goats upon his farm are given in Bulletin No. 27, of this Bureau, "Information concerning the Angora goat." In a recent published statement Dr. Standley says:

> A few years ago I turned a flock of Angoras into 640 acres of brush land that was not worth a penny to me. In two years' time I had 640 acres of the finest blue grass you ever saw, worth more per acre than any land I had, and it did not cost me a cent to keep the goats. I claim to have discovered the genius of these animals to kill out everything except just what you want to grow. They nibble brush thickets out by the roots. It is not true, however, that the Angora needs no care and will just pick the dollars off the bushes and put them in the bank, as some say. You have to give them plenty of coarse food, weeds, and brush to eat and keep good fences around them.

Because there are some who are skeptical about the ability of goats to clear up brushwood so perfectly as was stated in Bulletin No. 27 it is deemed advisable to include here, in addition to those above, a few remarks on that subject from different sources. A year's experience has been added, and during that time they have been at work in more States and on a larger number of farms. No statement has ever reached this Bureau from anyone who has seen goats given an opportunity at brushwood to the effect that they will not do the work expected of them in a rapid and successful manner. The statements follow:

They eat the leaves off every tree and bush that grows in Kansas, and, not content with the leaves, they want the bark also. They eat every weed which grows that I know of, except mullen and burdock. They seem tickled to death when they strike a patch of jimson weed. They are perfectly happy in a bunch of smartweed. They watch and patiently wait for a thistle to put forth its bloom so they can enjoy that rare morsel. Buckbrush, which is destroying so many of our fine pastures, is their delight. In fact, goats are ideal brush exterminators. They do it at a cash profit, instead of a costly outlay. One writer speaks of them as picking gold off the brushes. They are always sure of a good living, for no matter how dry or wet a season may be, it always produces brush and weeds. They will condescend to eat grass when there is no brush or weeds in sight. After the frost has killed the weeds and leaves they feed during the winter, so long as it is not covered with snow, on the blue grass which grew undisturbed under their feet during the summer. Horses, cattle, and sheep will feed after goats in the same pasture, while goats feed on that which other animals will not touch. One need not sell any of the stock already owned to make room for the Angora goat. The farm is able to take care of that much more stock, and render that much greater income. They are a vegetable scavenger. Hence its value in farm economy in converting into money the weeds and brush on which the farmer every year spends time, labor, and money to get rid of at the season of the year when time is most valuable.—*R. C. Johnston, Lawrence, Kans.*

There are about 400 goats in Montgomery County. About half of this number are Angoras and are doing valuable service in the way of reclaiming timber or waste land and turning it into green pastures. This work is well worth their cost, not to speak of the profit reaped from their mohair and the increase. It is marvelous the way they have changed some of my land from its former condition, which was covered so thick with underbrush that a horseman could not ride through, and to-day the brush trees are dead, and in their place grows beautiful blue grass. People passing stop in amazement and comment on the great work these goats are doing. In fact, goats are the ideal brush exterminators. They do it at a cash profit instead of a costly outlay.—*J. V. Nebel, Montgomery County, Mo.*

Angora goats are great brush clearers. They are very hardy, easily kept, and breed as fast as sheep. They do not cut the grass down to the very roots like sheep, but live more on browse; in fact, the Angora eats browse as a steady diet and grass for dessert, while the sheep eats grass as a steady diet and a little browse as dessert. Sheep do not move around until the grass is eaten down so as to almost kill it, and then they move on and repeat, while the goat is always in motion, and therefore does not crop the feed so close, but gives it a chance to grow.—*Arthur Hauser, manager of farm of C. E. Rollins, of Chicago.*

We have many thousands of acres of territory on the Pacific coast, as well as elsewhere, which seems to have been placed here by the Creator for the Angora goat. In fact, it has proven to be valueless for any other purpose as yet. But, through the rapidly increasing knowledge of the Angora, the unlimited wilds are rapidly passing from the Government to the owners of Angoras, and, instead of remaining as worthless space, they will be checkered with flocks of Angora goats and with schoolhouses.—*H. H. Harlan, Williams, Cal.*

We have goats running in a pasture, and it was a great wilderness of brush; but when frost came there was hardly a green leaf to be found. Since the fall rains the blue grass has started where the brush was the thickest. Our goats added $7 an acre to the value of our brush land just this summer.—*Mosier Bros., Mountayr, Iowa.*

In addition to the production of fleece, the goats are invaluable as clearers of land. I have had much experience in handling Angora goats, and it is a low estimate to say that a flock of 1,000 goats will in five years clear up the densest undergrowth that can possibly grow on 2,000 acres of land.—*Peter Corbett, Oakland, Md.*

A few years ago the Colorado River washed away a great deal of my field fence and covered the bottom land with cockleburs all along the river. It looked like a forest of cockleburs. To save the crop I had to build a new fence, joining the river on the upper side of the field so that goats could not keep down the weeds along the river inside of the field, but they kept all the cockleburs eaten up clean so far as they could go. Last winter I hired help to beat down the ripe cockleburs from the dead bushes inside the field and built a new fence of eight wires parallel with the river and opened the whole bottom to the goats this spring after shearing. At that time the cockleburs and elder bushes had entirely covered the entire bottom for the distance of a mile, and it looked like the goats would get lost in there, but after about two months I had the great pleasure to see that the bottom was as clean from cockleburs and elder as pecan gatherers may wish for.—*H. T. Fuchs, Marble Falls, Tex.*

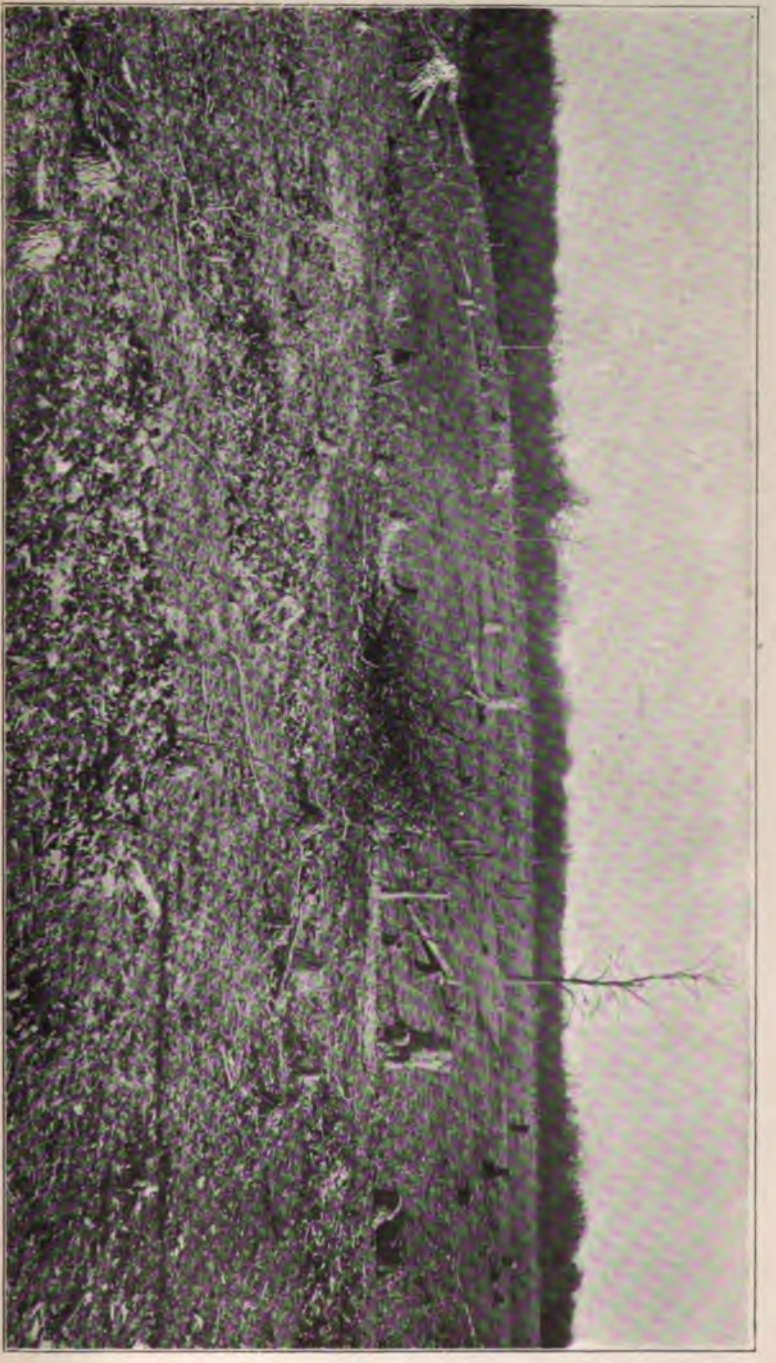
The goats' natural food is weeds, leaves, twigs, and when pastured upon timbered land will clean up and destroy all brush, briers, and weeds of all kinds that come within their reach, and while doing this their droppings serve to fertilize the land and make it more productive for either grass, grain, or fruit. We were shown a strip where a rail fence had stood for many years, the corners grown thick with brush and briers, also a 30-acre lot near by upon which the goats were turned this spring, and now there is not a leaf, green twig, or a live thing to be seen except the grass commencing to grow where previously the brush and briers covered nearly the entire surface. A second trimming later in the season will kill all the brush, briers, and weeds, leaving the roots to decay and the ground in fine condition for pasture or for cultivation, as the owner may desire to use it.—*Mena (Ark.) Star, July 4, 1901.*

As an exterminator of brush and weeds the Angora is unequaled by any other animal. If confined to small brushy pastures the goats will, within a short time, kill the woody growth by their constant browsing of the leaves and tender shoots of the brush and by girdling the trees if tender bark. While this process of redeeming the land is going forward they improve the fertility of the soil by evenly spreading over its rich surface their deposits of rich manure, thus accomplishing the double purpose of clearing the land and fertilizing it.—*J. C. Hobson, Sonoma, Calif.*

OBJECTIONS TO SOME BRUSHWOOD.

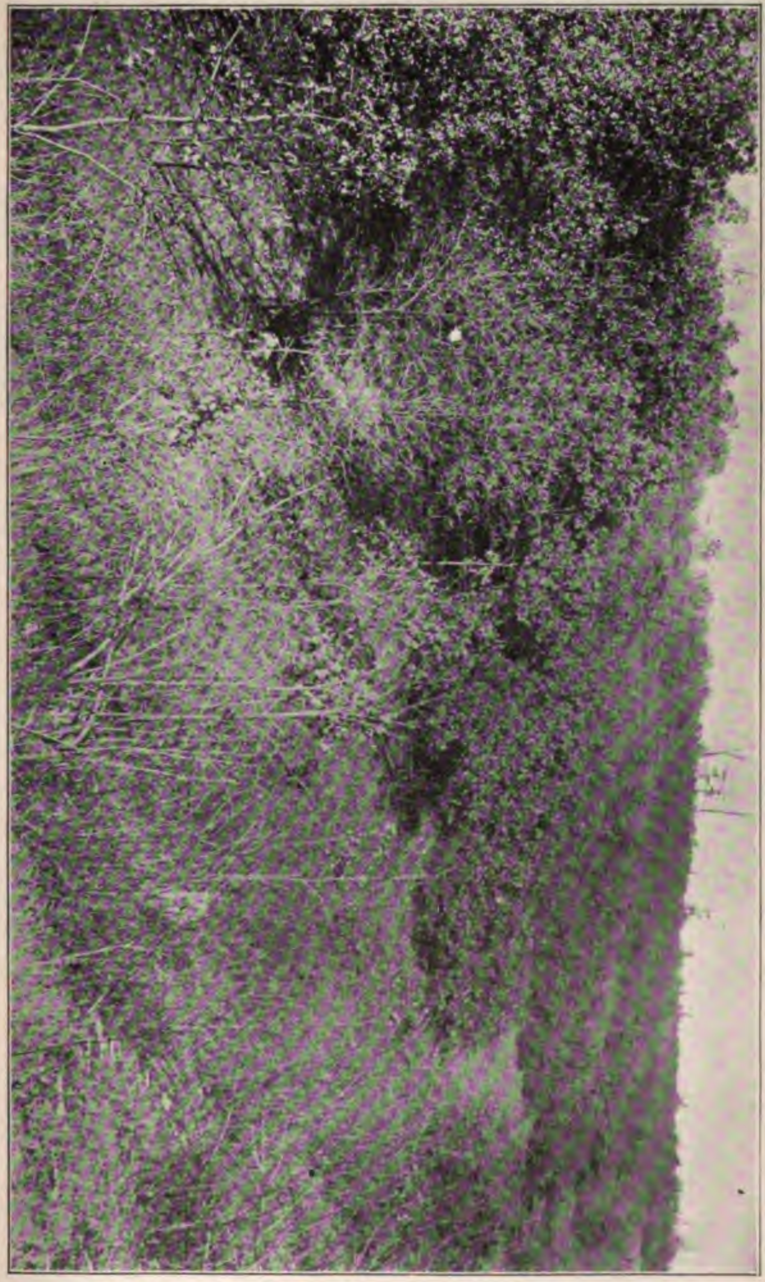
The statement has been reiterated over and over by the newspapers recently, in mentioning the spread of the Angora goat industry, that these goats will eat all kinds of poisonous plants without any harmful results. While there is much evidence pointing to this conclusion, it ought not to be taken as a settled fact. If experiments were undertaken it might be shown that a plant which is poisonous to sheep or cattle is also injurious to goats. It is observed that goats feed upon

What Goats did in less than a Month.



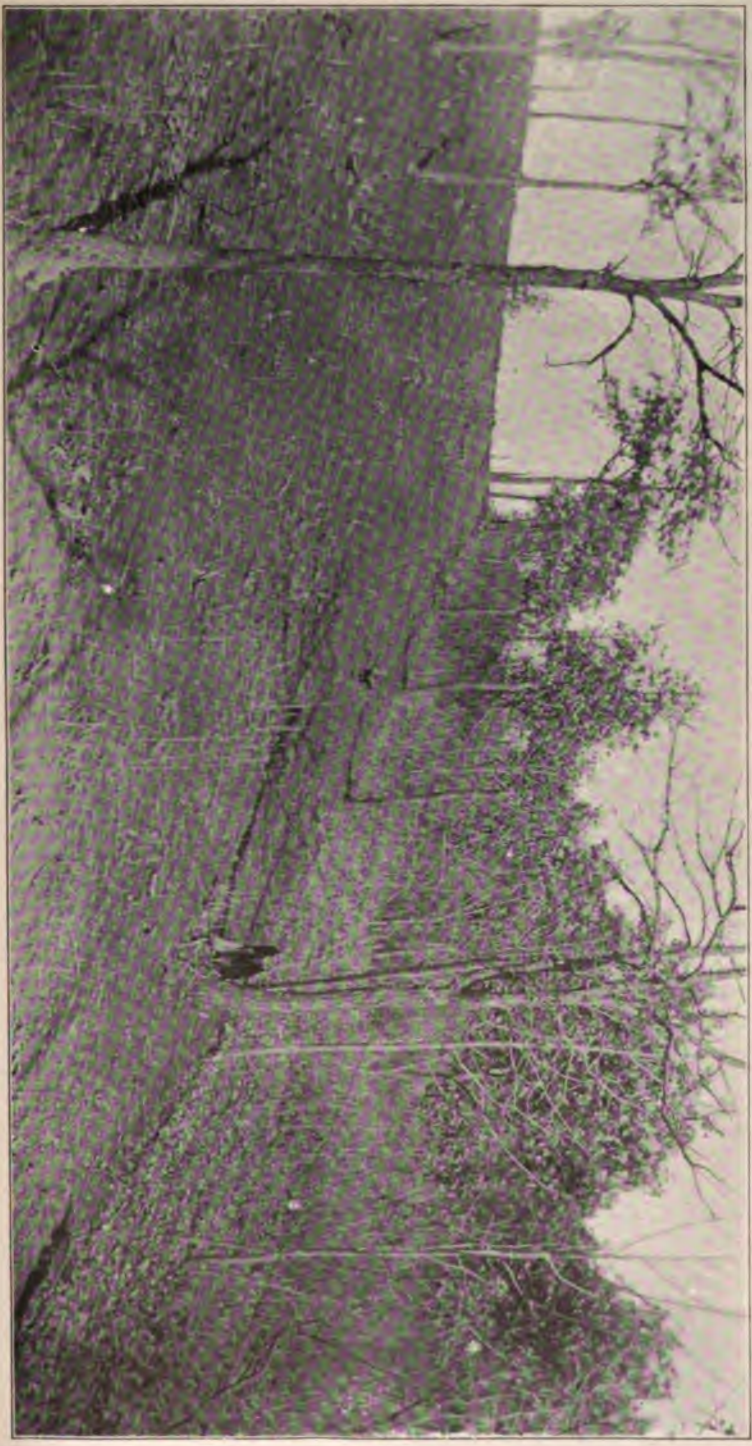
THE WORK OF GOATS ON LAND WHICH ONCE LOOKED LIKE THAT SHOWN IN PLATE LXXVIII.

Photogr



THE VIEW SHOWN IN PLATE LXXVII LOOKED LIKE THIS BEFORE GOATS WERE TURNED IN.

Photograph furnished by George H. Baldwin.



WHAT GOATS DID ON BRUSHWOOD IN IOWA.

Photograph furnished by Q. M. Beck.

brushwood by snipping off a leaf here and there—from a pine here and a cedar there, a grass blade here and a weed top there, and so on; they do not, like the sheep or cow, eat a weed entirely or strip a bush clean before passing on. The result is that the goat's stomach is filled with a great variety of food and not much of any one kind. If by chance a few poisonous leaves are eaten, they are probably neutralized by the large quantity of other food eaten.

Upon a farm in Pennsylvania there was a patch of laurel where goats had passed it by during the whole season. This was evidence that they knew it was not good for them. Later in the season several hundred goats were turned into that same pasture after a long journey and when they were very hungry. The laurel patch was the only green food in sight and they ate of it greedily. The next morning found 300 of them very sick and 50 dead. What had proved harmless to the goats that had been there when there was an abundance of other feed proved exceedingly poisonous to the hungry newcomers.

While it is possible that goats may not eat laurel to such an extent as to be injurious if placed in a pasture where it is growing with other browse, it can not be considered a safe practice. The owner of the Pennsylvania farm referred to found it to be a short job and not expensive to "snake" out his laurel patches with a team and log chain. So brushwood need not be abandoned because there are patches of laurel upon it.

The laurel best known is the narrow-leaf variety (*Kalmia latifolia*). According to Dr. V. K. Chesnut[a] this species "is abundant in the northeastern section of the United States, where it is also known as sheep laurel and lambkill. The leaves contain andromedotoxin, and sheep and calves are quite frequently poisoned by eating them."

The greenbrier, which appears to have a wide distribution in the United States, is an enemy to goat raising; not that it is poisonous, but because of its physical character. It is a climbing shrub, very wiry, and well covered with very hard and tenacious thorns. They grow in clumps and to great length, and preferably on lowland near creeks or ponds. It is a very easy matter for these thorns to catch in the fleece and hold the animal fast until it dies. No goat has strength sufficient to break the shrub and the thorns do not give way. This shrub should be cut down with a brush scythe and burned before goats are permitted to go among them. Where goats have had access to greenbriers immediately after shearing, when there is no fleece to catch upon the thorns, they have destroyed the briers by eating the leaves and by girdling.

It is probable that large blackberry briers may be objectionable for the same reason, but ordinarily goats will destroy them without much difficulty. If goats have an opportunity to get at any of these briers as they are putting out in the spring they will not permit them to mature.

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[a] Bu. An. Ind. Rpt. 1898, p. 411.

It must not be understood that goats can do very much toward destroying trees which reach the sapling stage of growth. They will stand on their hind legs and eat the leaves off such trees at a height of about 6 feet, and sometimes peel the bark from them. Larger trees must be destroyed by other means. Most goat raisers will find it advantageous to cut the trees so that the goats can get at the leaves and twigs. This matter is discussed more fully under the heading, "Winter care and feeding."

AS MOHAIR PRODUCERS.

While the wide distribution of Angora goats in 1901 was due primarily to their ability to convert brushland into pastures and fields, their usefulness as mohair producers has not been overlooked. This is a source of profit that is always worth considering. The amount of this profit depends to a very large extent upon the quality of the goats. It was stated in Bulletin No. 27 that all crosses of Angoras upon common goats are called Angoras; and this is also true of the high crosses till the thoroughbred is reached. These lower crosses destroy brush equally as well as the thoroughbreds, and they also produce a fleece that is worth something, but the same feed and care would support goats which yield fleeces of greater weight and finer quality, and which, consequently, would bring a better price in the market.

With this thought in mind, many who have entered upon this industry have purchased a good grade of goats in order that their worth as brush destroyers might be supplemented by their fleeces, which would probably bring on an average about $1.25 per head.

But this is not all. Those who become the possessors of the best goats have learned that the kids which they may have for sale bring high prices. It costs no more for care and feed to raise a high-grade or thoroughbred kid than a low-grade one.

In another place (pp. 480–492) in this report is an article on "Mohair and mohair manufactures," which was written to encourage the growing of a good quality of mohair. It is suggested that this article be read by any who may contemplate the purchase of Angora goats, as the uses of the various grades of mohair and their approximate value are discussed therein quite fully.

GOATS AS GRAZERS.

It is true that "goats are browsers by nature, and there is no vegetation they will eat in preference to leaves and twigs of bushes," but it does not follow that they will not thrive on grass. Bulletin No. 27 quotes Philo Ogden, of California, as an authority who is a strong believer in grass for goats. He claims that the fleece grows heavier on grass, has greater luster, and less wax, or gum, and that the animals grow larger than if raised on browse.

John S. Harris, of Salem, Oreg., is also a believer in grass for goats. He maintains that the fleece grown on grass is superior in almost every respect. He says a little browse will do no injury, but all grass as feed will do no harm. S. S. Brannin, Silver, Mont., whose goats subsist largely upon grass, believes, with the greater number of goat men, that a mixture of diet is the best. He says all stock become very fat upon the gramma, or buffalo, grass which grows there, and adds this interesting note: "I have taken over 20 pounds of rendered tallow out of one three-year-old wether which dressed 65 pounds."

The view shown in Plate LXXX is a flock of goats grazing upon bunch grass, and was photographed on the ranch of S. S. Brannin. Other views of the range conditions are shown in Plates LXXXI and LXXXII. These were also photographed on Mr. Brannin's ranch.

In connection with the predilection of goats for browse, an interesting note of exception comes to the writer from Henry F. Granger, of New York City. He says:

> They were pastured last summer in a lot full of every variety of bush and weed, and it kept one man pretty busy chasing them out of an adjoining new seeded meadow of timothy and clover, which they seemed to relish above everything else. Three friends of mine who imported with me had the same experience and sold at a sacrifice because they could not hold them, and the brush-eating goat evinced a nice discrimination for clean clover and timothy. My bunch may have peculiar habits.

WINTER CARE AND FEEDING.

Information which has been received by the Bureau of Animal Industry through correspondence shows that the press, in its efforts to exploit the good features of these goats, has to some extent exaggerated the facts. It seems to be a favorite saying that "they live on nothing," and men who would not think of putting a horse, a cow, or a hog upon its own resources in a pasture in winter where the snow may be a foot deep have done so with their goats, and have wondered why they did not thrive. Now, it is true that thousands of goats pass through a winter and thrive well where the snow is deep and the thermometer low, but they get something to eat every day, and plenty of it. The goat will browse just as eagerly in the winter upon soft twigs as in the summer, but the twigs must be within his reach.

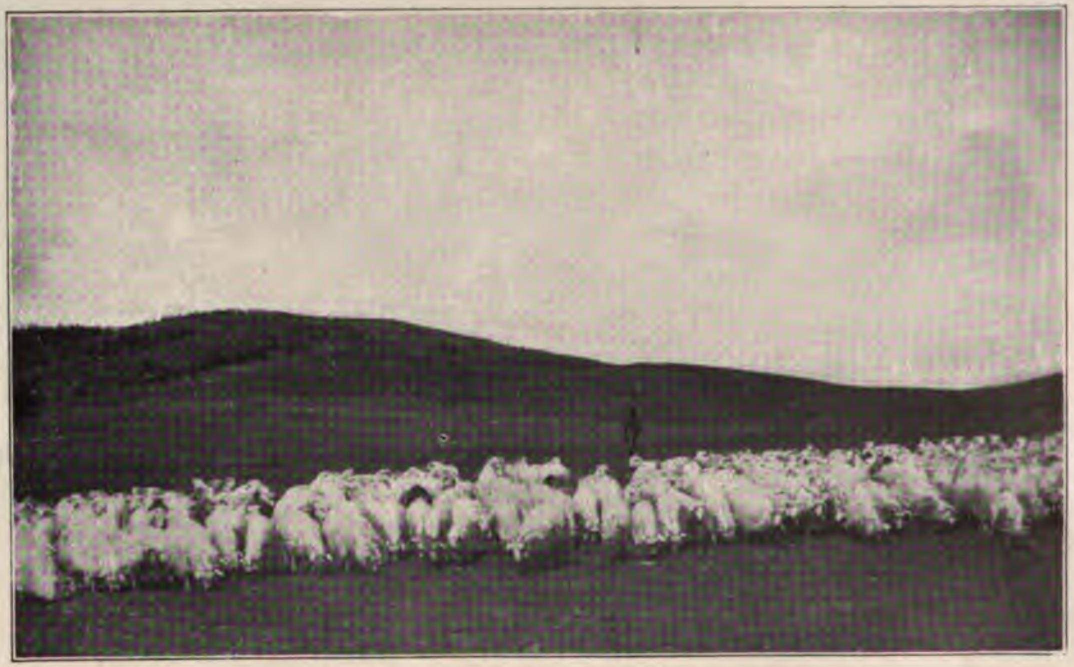
Goat men of experience leave all trees which the goats can not destroy in the summer until the winter and then cut them down. It is "a goat's paradise," as one correspondent states, to be in these tree tops. They will eat the soft part of the twig—2 to 4 inches. This is feed for goats—and good feed, too—although it is such as no other one of our domestic animals will subsist upon. Q. M. Beck, Beargrove, Iowa, sends the Bureau a photograph (Pl. LXXXIII) showing Angora goats browsing upon the tops of trees which he was cutting for wood. Although the ground is well covered with snow (the picture was taken in January), the goats are keeping themselves in good condition upon the tree tops and such leaves as they can find, for they will sometimes eat dry leaves as if they were the choicest delicacy.

There is another feature of winter browsing which is of importance, and that is that the goats ought to enter the winter in good condition. If for any reason they can not get into good condition in the summer and fall, when there is so great an abundance and variety of brush and weeds, little can be expected of them in winter on feed less in quantity and kind. On every farm where goats are kept some sort of coarse fodder and grain should be provided, in order that they may be available at times when storms will keep the goats under cover. Some winters this sort of weather may last only a day or two, while in others there may be two or three weeks of it.

No amount of cold will prove injurious to the goats, but the caution may well be repeated that they should be kept dry, especially in cold weather. A shed of easy access that will turn water is one of the essentials of goat raising. It should be so constructed that the water will not drop from the eaves. It should not, however, be perfectly tight, so that the air can not have the freest circulation. Many goats will die from being too closely confined in warm sheds or barns before their owners will realize the fact. Kindness in this respect is dangerous and expensive.

S. S. Brannin, of Silver, Mont., who has had good success in raising Angora goats in that State, where the thermometer frequently falls as low as 20° below zero in the winter, was requested by the Bureau of Animal Industry to write, for use in this report, some of his practices, especially on winter feeding and care. His letter follows:

> The care of the Angora goat in this State in the winter is very simple and easy. Any shed or shelter that will do for cattle or sheep will do for Angora goats. The thing most necessary is a good roof to protect the goats from the wet. If they have to lie in the mud or on the wet ground in cold weather they will not do so well. They will stand any amount of cold if kept dry.
>
> As to the goats feeding upon grass or brush, my experience has been that the greater the variety of grass, brush, and weeds, the better the quality of the mohair. They seem to do well in this State upon the gramma, or buffalo, grass as it is very nutritious, and all stock get very fat upon it.
>
> Any kind of pasture which will keep goats fat will produce a good quality of mohair and meat. No goat that is poorly fed will produce a good quality of mohair.
>
> Any place in the foothills of the Rocky Mountains is suitable for Angora goats, for there is a great abundance of feed of all kinds which make it a goat's paradise. The goats get very fat. I have taken over 20 pounds of rendered tallow out of one 3-year-old Angora wether which dressed 65 pounds.
>
> As to feed in winter, they require very little when compared with other stock on



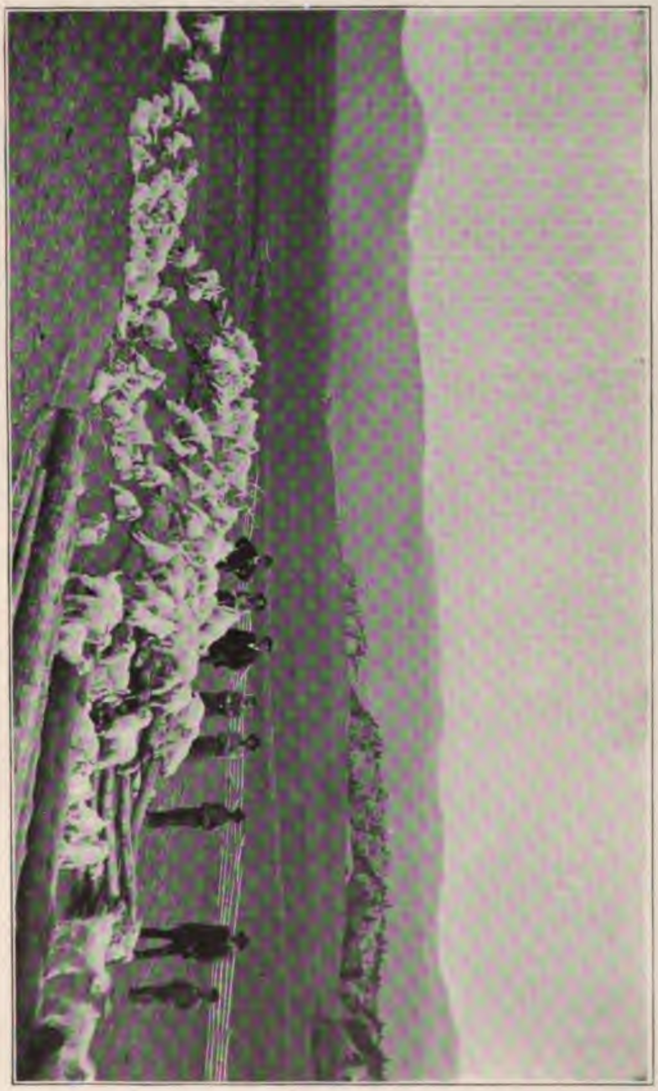
ANGORA GOATS GRAZING IN MONTANA.

Photograph furnished by John W. Fulton.

MONTANA GOAT RANGE. KIDS AT LEFT OF SHEDS.

Photograph furnished by John W. Fulton.

MONTANA GOAT RANGE. KIDS AT LEFT OF SHEDS.
Photograph furnished by John W. Fulton.



KIDS ON THE BRANNIN RANCH, MONTANA.

Photograph furnished by John W. Fulton.

ANGORA GOATS BROWSING IN WINTER.
Photograph furnished by Q. M Beck.

the same range, as they will paw down through a foot or more of snow to get at the grass, or they will travel around the edges of the timber where the snow drifts and packs, and browse upon the brush. They are particularly fond of the pine straw (needles) or the foliage of the red fir. They will even browse upon these in the summer time when there is an abundance of other vegetation in reach.

I have wintered them at an altitude of nearly 6,000 feet. I feed them in winter only when it is very stormy or extremely cold, when it is 15° or 20° F. below zero, which is only a few days at a time.

I have also noticed that all of the low-grade goats that have been brought here from New Mexico and were bare upon the breast and belly, have become entirely covered on the neck and belly like a high-grade Angora. This I consider a most wonderful change to take place upon the same animal.

PRICES OF GOATS AND MOHAIR.

The one question which has been asked of this Bureau more than any other concerning this industry is, What are the prices of Angora goats? It is a question which can not be answered definitely, owing to the many grades of Angoras as well as to the individual differences among the animals of the same cross. The greater the distance from the source of supply the more is their value increased. The great demand for these goats which has ruled for more than a year has caused the prices of good animals to range very high; and, as those who are purchasing recognize the fact that the future profits are in the animals of good quality, prices are likely to remain high.

Prices for good does range from $10 to $25 at this time. One breeder in the East sold 50 head at $25 each. Twenty-four sold at auction at Kansas City in October at $17 each. Bucks, like the males of all domestic animals, bring varying prices, which have ranged during 1901 from $20 for a fairly good kid to $100 for animals two or three years old. It is not a rare occurrence, however, for a buck to sell for several hundred dollars. For instance, the sweepstakes prize buck at the Kansas City show sold for $1,050, and the buck which took the second prize in that contest brought $510.

It is possible to go into the Southwest, the principal source of present supply, and purchase goats at lower figures than those named above; but many of them are not high grades, and those which are high grade become expensive when expressage or freight is paid to distant points.

The prices of mohair and the influence affecting them are discussed in the article on "Mohair and mohair manufactures" (pp. 480–492). The effort is made in that article to show, not only that better prices would rule for a better grade of mohair, but that the fleeces now produced, if properly cleaned and sorted, would bring more money than they do now.

SHEARING.

The operation of shearing is always a proper subject for consideration. The use of machine clippers is coming more and more into favor, because the fleece is taken off evenly, double cutting is avoided, and the chances of cutting the animal are reduced to a minimum. There are those, however, who still prefer the hand shears, and there are more who are using them because they do not own a sufficient number of goats to warrant the purchase of machines. Plate LXXXVII shows a goat carrying a fleece and the same goat after having been sheared.

Goats are not so gentle in the hands of the shearer as sheep, and many men, especially among beginners in the industry, are anxious to know how best to handle them during the operation of shearing.

F. W. Ludlow, of Lake Valley, N. Mex., has devised a shearing table which has proved to be of great service to himself and to others. It is a collapsible trough, or combination table and trough. Plate LXXXIX shows this table in use, while figure 210 is an outline drawing, which will show more clearly than the photograph how it can be made. It will be noticed that it is very simple, and it is equally suited to hand and machine shearing.

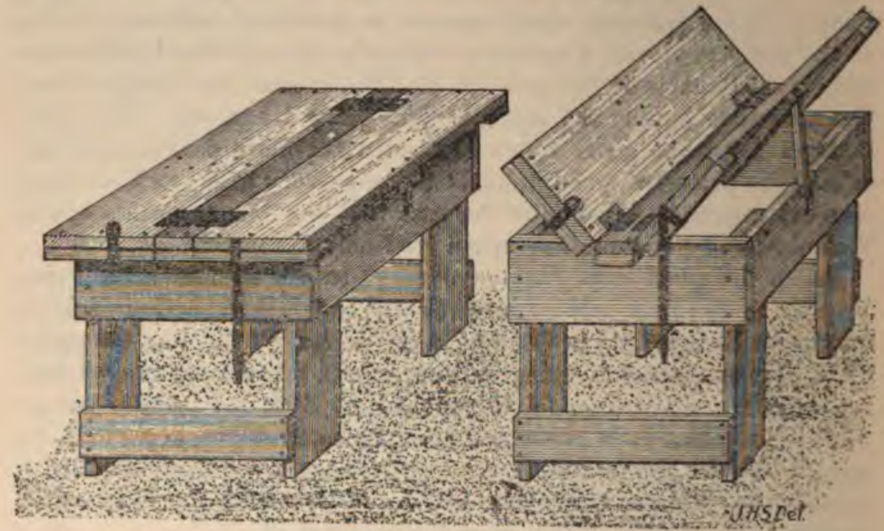


FIG. 210.—Combination shearing trough and table.

This table is first used in the shape of a trough. The goat is placed in it on its back and held down by means of a strap across the throat. While in this position all the underparts, sides, and legs may be worked upon. Mr. Ludlow says that in machine shearing it is a good plan to start at the brisket and shear all the belly as far back as possible; then shear the front legs and neck; then start at the hocks and shear up the hind legs and along the sides to the point of beginning. After shearing one of the sides allowed by the trough, the goat is tied—"hog-tied," to use a Western expression· that is, all four feet are tied together. The sides of the trough are now dropped, forming a table upon which to finish the operation. The illustration shows that there is now free access from the tail to the head, and the goat remains helpless. In the illustration the fleece already cut has been pulled away in order that the table might be shown, but the proper course is to leave all the fleece upon the table until the goat is liberated, and then roll it up inside out.

Mr. Ludlow's description of this table is given herewith:

> The table is simple in construction. It is about 22 inches high, 2 feet 10 inches long, and 21 inches wide. The top is composed of two 9-inch sides, which are hinged to the 3-inch centerpiece. On the lower side of these movable flaps is a narrow piece 8 inches long, which catches on the framework of the table when the sides are lifted and holds them stationary. When the sides are elevated, the top of the table forms a trough 3 inches wide at the bottom and possibly a foot wide at the top. Into this trough the goat to be shorn is thrown feet up. A small strap, which hangs from the end of one of the sides, is run over the goat's neck and fastened to the other side. The goat's head is hanging over the end of the table and the strap prevents it getting free. The belly and legs are then shorn. The legs of the goat are then tied together, the strap removed from the neck, and the sides of the table dropped, so that one has a plane surface on which to shear the rest of the animal. An untrained man can shear 100 goats a day with a shearing machine and such a table.

DOGS VERSUS GOATS.

Much has been said in the press about the ability of Angora goats to resist the attacks of dogs. Probably the most general drawback to the raising of sheep is the liability of the sheep to be attacked by dogs. Goats do not suffer from the attacks of dogs except in rare instances, if the reports which reach this Bureau through correspondence and the press may be used as a basis of opinion. The bucks are "born fighters," and the does may easily be trained to defend themselves and their kids. Because of their pugnacious disposition toward dogs, they are frequently employed in small numbers—say one to three—to run in flocks of sheep as a protection from dogs. A few will remain with sheep, but a larger number are apt to separate themselves from the sheep and to flock by themselves.

Two or three newspaper reports have been received at the Bureau of Animal Industry which state that dogs have killed Angora goats, but these could not be verified. Still, it is not impossible that several dogs might overpower a goat, and there is no doubt they would do so if they could; and it should not be understood, as some inquiries would seem to indicate, that kids can defend themselves any better than a lamb can. Ordinarily an Angora buck will vanquish a dog, and it is not believed that the goat industry will suffer to any appreciable extent from the ravages of dogs.

Notwithstanding all this, it will be wise for the owner of a flock of these goats to keep a close watch upon them until they demonstrate that they can care for themselves in a contest with dogs. When we read the statement of such an authority as Mr. H. T. Fuchs, Marble Falls, Tex.,[a] showing how he trains the does to fight, and then read a statement of Mr. Philo Ogden, already quoted, referring to the fighting qualities of this goat as "fiction," we are led to suspect that there may be something in the matter of training for defense. It must be remembered that Angora goats are remarkably intelligent and learn readily; and so it is often the case that there are characteristics in one flock of Angoras which are entirely absent in another.

In order that the goat men may have the benefit of the opinion of one who has had much experience in the business of Angora goat raising, the following is quoted from Mr. Ogden:

> I have waited a long time for some of the older breeders of Angoras to correct the prevailing opinion of the wonderful fighting qualities of the Angora—how it kills dogs and wolves and other troublesome animals which intrude upon its territory. Men who write about their goats driving off or killing stray curs and other animals simply advertise the Spanish or other base blood in their flocks, for the pure Angora has about as much fight in him as a jack rabbit. It is the most timid and nervous of our domesticated animals. By patience and kind treatment the herder and his dog can gain their confidence, but let a strange dog or man come near the flock and they get excited and bunch up together. If a dog, wolf, or other animal attack them, they will run to the highest point near them and bunch up. The old bucks, stags, and the strongest animals—supposed fighters—will crowd to the center of the flock and stamp their fore feet and show defiance when out of danger. The weakest goats are forced to the outside of the bunch, and are the ones killed by dogs and wild animals. This bunching up often saves them from attack, but if a dog or other animal has the courage to grab a goat, the flock will sway back and finally break for another elevation, and again bunch up and wait for the dog or wolf to pick up some of the weaker goats crowded to the outside. I have watched these maneuvers and have never yet seen any attempt to rescue the unfortunate goat caught.

IMPORTATIONS.

Previous to 1901 the last Angora goats that had been imported into the United States from Asia Minor were twelve in number (two bucks and ten does), and were personally selected and imported by John S. Harris,[b] now of Salem, Oreg.; and previous to 1901 he and Israel S. Diehl were the only importers who went into the villayet of Angora for their animals.

C. P. Bailey & Sons Company, of San Jose, Cal., imported two bucks from South Africa in 1893 and another one from the same place in 1899.

William M. Landrum, of Laguna, Tex., a man who has been breeding Angora goats for forty years and more, and who was the first to introduce them into California, succeeded in importing two yearling bucks from South Africa in 1901. They arrived at New York on April

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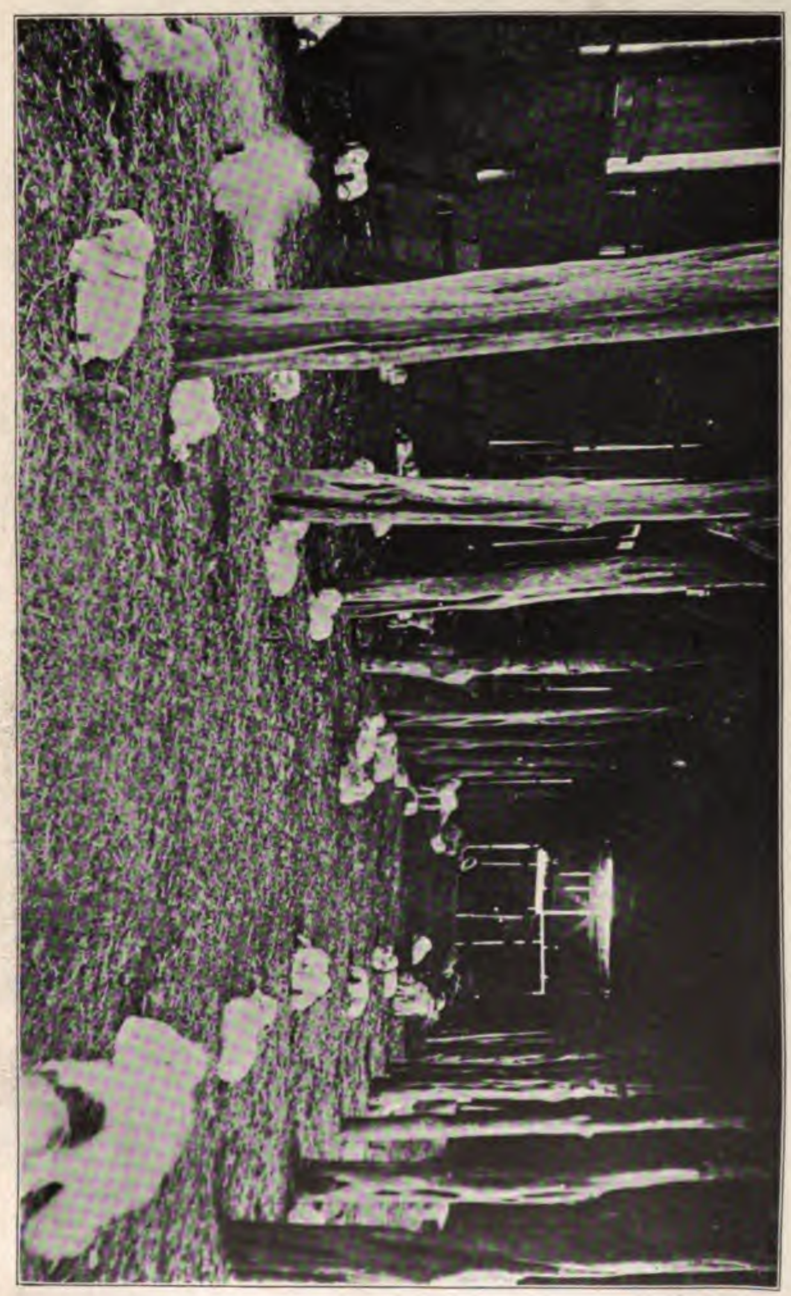
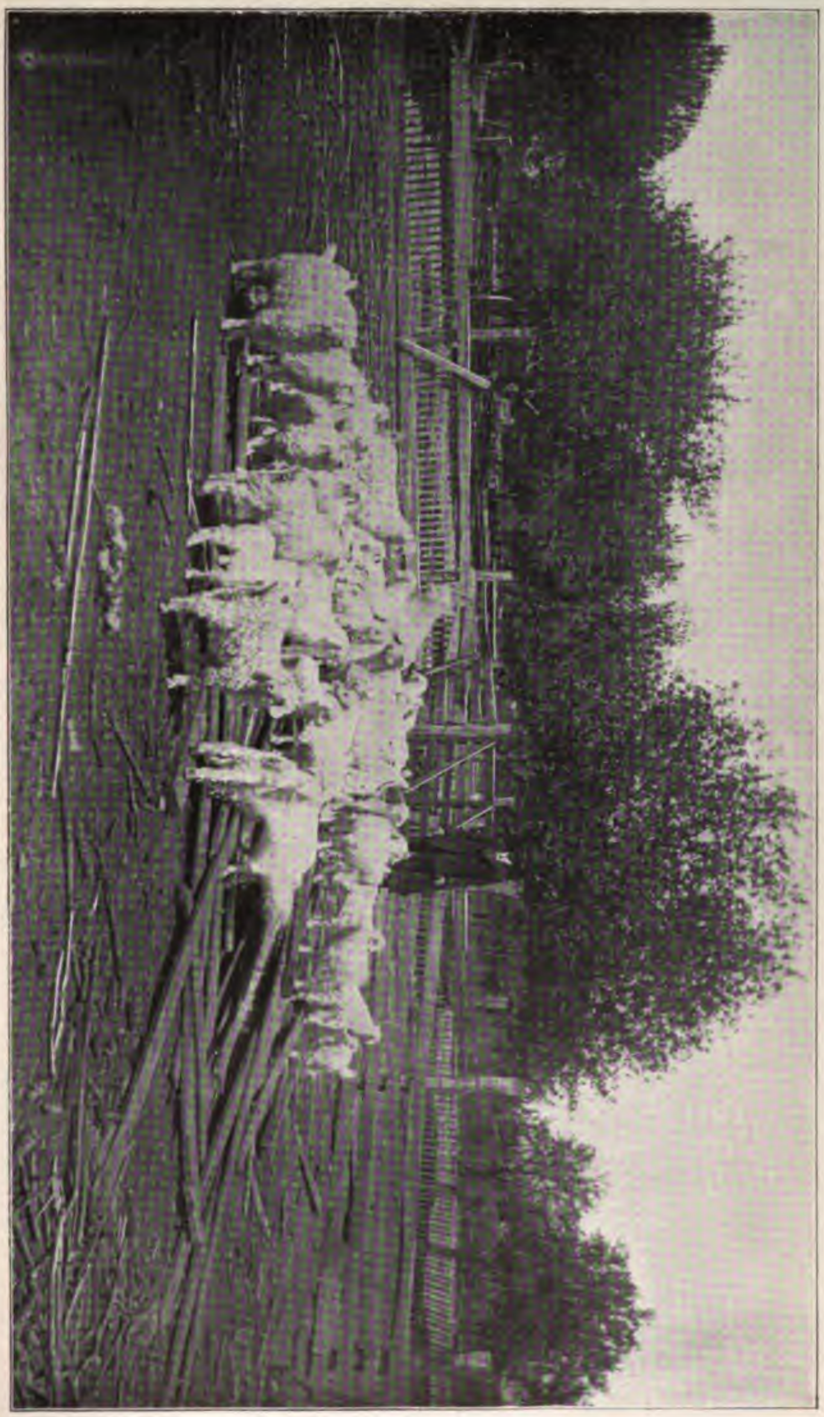
[a] Bu. An. Ind., Bul. No. 27, p. 53.

[b] It is an interesting fact in connection with Mr. Harris's visit to Angora that, being there at the time when the telegraph line was completed, he sent out the first message from that point. He still holds the receipt showing this historical fact.—G. F. T.



KIDS STAKED IN GOAT SHED.

Photograph furnished by John W. Fulton.



A FLOCK OF KIDS IN ILLINOIS.

Photograph furnished by Jas. A. Moberley.

TWENTY-FOUR DOES WHICH SOLD FOR $17 EACH.

Photograph furnished by Jas. A. Moberley.

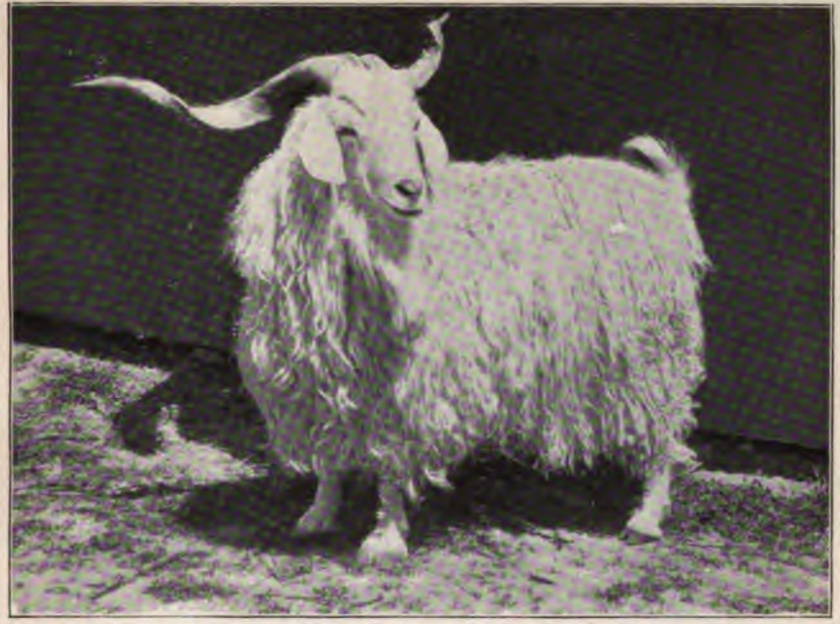


FIG. 1.—ANGORA GOAT BEFORE SHEARING

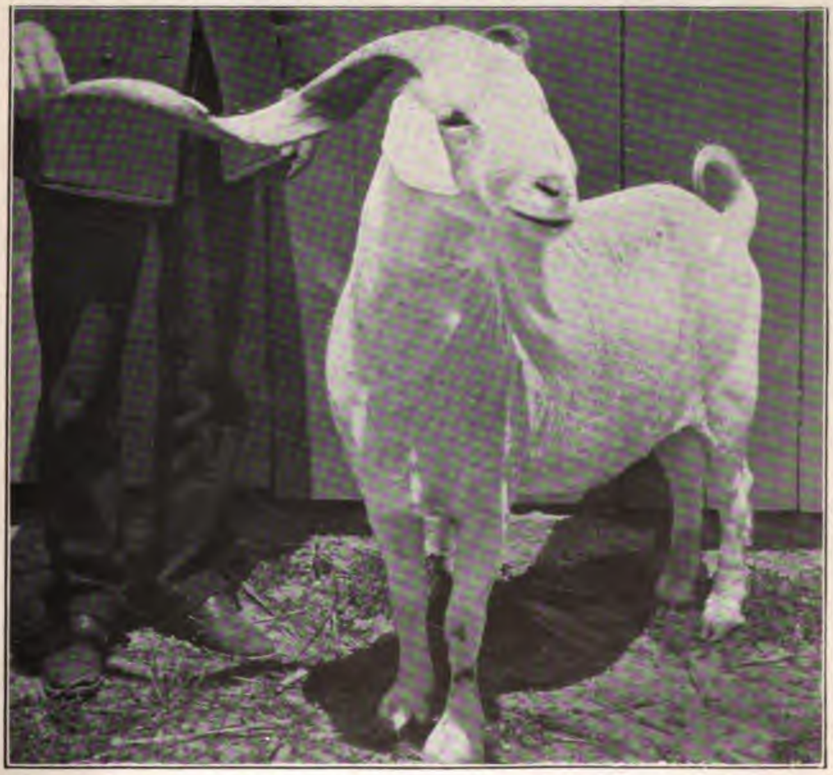


FIG. 2.—ANGORA GOAT AFTER SHEARING.
Photographs furnished by Jas. A. Moberley.

PLATE LXXXVIII.

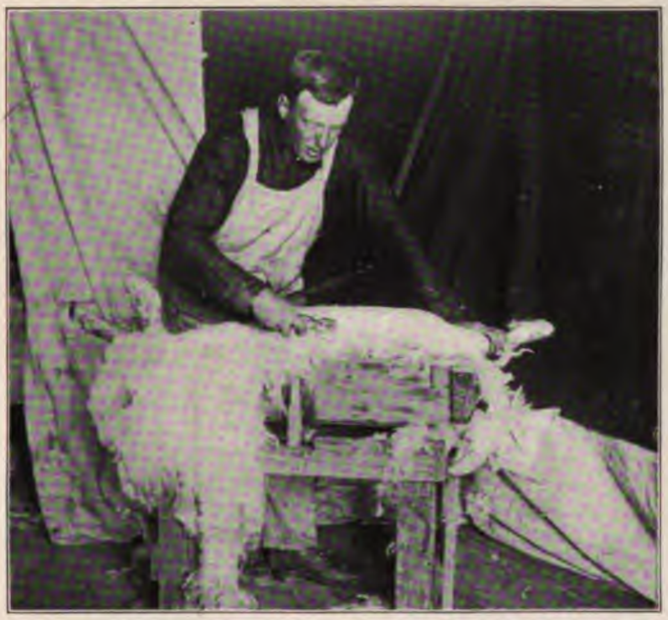


FIG. 1.—SHOWING GOAT IN SHEARING TROUGH.

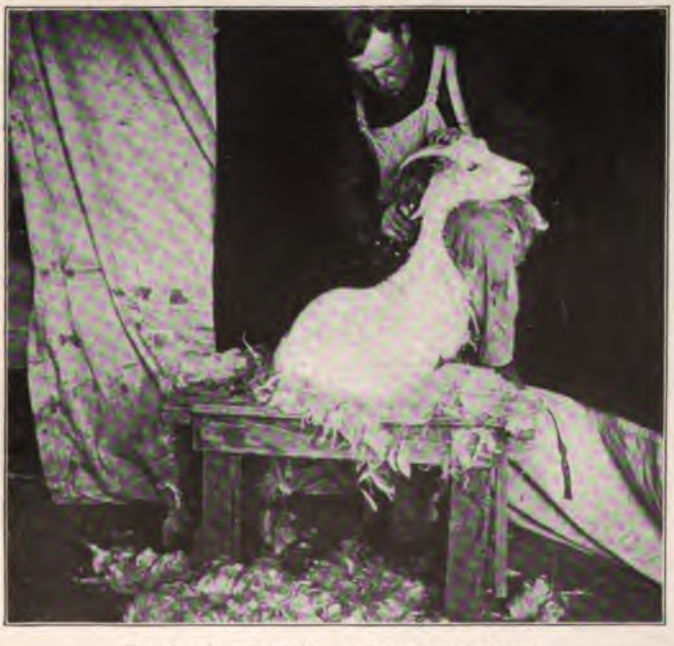


FIG. 2.—SHOWING GOAT ON SHEARING TABLE.

Photographs furnished by E. D. Ludlow & Co.

20, after being seventy days on the journey, and on May 2 arrived at Laguna. These two goats were bred by a South African breeder, Mr. R. C. Holmes, their sire being Dick, which was the prize buck at the Port Elizabeth show in 1900. These animals have not yet been on exhibition anywhere in this country so that they might be passed upon officially, but Mr. Landrum's own description, which delves a little into a history of which he is a part, is given herewith:

> They are large, well-formed, perfect goats in every point. They sheared 10¾ and 10½ pounds, respectively, of the finest fleece I have yet seen on an imported buck. The hair is 13 to 14 inches long, and so thick that it was difficult to shear it with common shears. The hair is the same length all over. There are no open spots inside the legs, on the flanks or brisket, and every inch of skin is covered with the same kind of fleece. When shorn the fleeces were turned flesh side up and examined for kemp. Most of the leading breeders of the country were there, including George W. Baylor, Mr. Harris's partner. They were all challenged to find one kemp, and it could not be found. These bucks are strictly free from kemp and bare spots anywhere. They had no pointed ringlets, as the hair is all of the same length.
>
> These are the most perfect goats I have ever seen, and I have seen all but a very few of all that have been imported to the United States. Those who thought that there are no first-class Angoras in South Africa have been mistaken. Pasha is a better goat than any that ever came to America from Turkey, and these are even more perfect than Pasha. Of the goats from Turkey some have had one fine point and some another, but I have never seen a goat before with all the good points these have. The Davis goats had the finest fleece in the world, but it was confined to their sides. Their bellies and throats were naked, and they had coarse hair on their backs. Diehl had some good goats, but none perfect. Chenery had four or five ewes almost perfect, but no bucks to equal them. A perfect animal in any breed is hard to get.

The Bureau of Animal Industry received samples of the mohair from these two goats, which are very fine and lustrous, and the only samples among the many which the Bureau has which are free from kemp. Prof. E. F. Pernot, of the Oregon Agricultural College, measured samples of mohair from these goats and found that their diameters were, respectively, 0.00177 and 0.00218 of an inch. While this is very fine, it is equaled by many goats which have been bred in our own country; but the length and weight of the fleece of these South African bucks and their freedom from kemp are qualities of highest desirability.

A picture of these two bucks is shown herewith (Pl. XC, fig. 1).

The only other importation in 1901 was by C. P. Bailey & Sons Company. Dr. W. C. Bailey of this firm spent the winter of 1900–1901 in Asia Minor investigating the Angora goat industry there, and his report appears on pages 493–506. Although the Ottoman Empire has strictly forbidden the exportation of any Angora goats since 1881, Dr. Bailey purchased four animals and succeeded in getting them out safely, and they are now in California (Pl. XCI). He visited about every part of Asia Minor where the Angora goat industry is carried on, and has expressed himself as well contented with the individuals which he secured. Only an intimation of the difficulties with which he met are given in the following terse sentence written from Constantinople on the return trip:

> A ride on mule back, then on camels; a trip in a closed carriage; then to be tightly packed in a sack and carried for miles on a man's back; next to be given a hay ride on the Bosphorus (under a boat load of loose hay); to be shorn in cold weather and run through coal dust, only to look the death ax in the face, but to be saved by a "golden wand;" through the streets of the oriental capital in an open wagon, but looking more like dead animals than live ones; even now to be stopped three times by customs officials and the police, and as many times passed. They are out of the Ottoman Empire now, but they have yet a long and tiresome trip.

These goats, like the two imported from South Africa by Mr. Landrum, are said to be entirely free from kemp and are ideal individuals.

In a few years the industry in the United States should begin to feel the good effects of these importations, and mohair growers will be grateful to these men who have invested so much money and suffered so many hardships in order to obtain the best in the world.

SECOND ANNUAL EXHIBIT OF THE AMERICAN ANGORA GOAT BREEDERS' ASSOCIATION.

The second annual exhibit and sale of the American Angora Goat Breeders' Association was held at Kansas City, Mo., on October 24, 25, 26, and 28, 1901. There were on exhibition about 2,500 goats from all sections of the country except the East, and the attendance was so large as to convince everyone there that the interest in the little animal had become widespread. This interest was said to be much greater than during the first exhibit and sale, which was held in Kansas City the year before. It was particularly noticeable that those who were goat raisers and had goats for sale seemed less anxious to make sales than to learn whatever was to be learned about the animal. If there was any point that had been overlooked in breeding which should receive attention, it was their desire to know what that point was, how to attain the end desired, and why it was desirable to attain it. They had come to school to learn lessons by an interchange of opinions and experiences, and they freely remarked that they had not come in vain.

There were present at this meeting nearly all of the prominent breeders of Angora goats in the United States. Those who were in attendance were especially gratified to meet William M. Landrum, who, in 1861, was the first to take Angora goats into California, and who has been a breeder for forty years; also John S. Harris, who succeeded in importing ten animals from Asia Minor in 1876, these being the last from that country previous to 1901; and Dr. W. C. Bailey, who had but recently returned with four Angoras from a journey through Asia Minor.

The first meeting of the association was devoted to speeches and remarks on the Angora goat industry in general. Those who addressed the association were Col. William L. Black, Fort McKavett, Tex.; Dr. J. R. Standley, Platteville, Iowa; Gustav A. Hoerle, Ridgewood, N. J.; Dr. W. C. Bailey, San Jose, Cal.; George Fayette Thompson, representing the Bureau of Animal Industry; and Dr. Ed. R. Allen, of Kansas City, Kans. At a later meeting George G. Emery, of Sanford, Me., addressed the association on the values and uses of mohair. Inasmuch as Mr. Emery was familiar with every detail of mohair manufacture and was the purchasing agent for large mohair mills in the United States, his remarks had peculiar weight with the breeders. The purpose of Mr. Thompson's address was to show the need for better mohair, and the ideas advanced there are embodied in the article on "Mohair and mohair manufactures" (see pp. 480–492).

The Bureau of Animal Industry; the Sanford Mills, Sanford, Me.; and the Massachusetts Mohair Plush Company, Lowell, Mass., each had exhibits of mohair manufactures; and C. P. Bailey & Sons Company, San Jose, Cal., and W. G. Hughes & Co., Hastings, Tex., exhibited rugs made from the skins; the former also showed samples of gloves made from Angora skins. These exhibits were employed as illustrations of how the different grades of mohair are used; and they convinced the breeders, as nothing else could do so well, of the necessity for better mohair. And so, when this show came to an end, the Angora goat industry had taken the first step toward an important advance, in that every breeder went home thoroughly impressed with the fact that the day of poor goats and poor mohair was passing.

The importance of good mohair as thus made prominent was not well known among many of the breeders before this time, and so it was not surprising to find many goats on exhibition which were really very poor individuals; but the owners were there to learn, and the result will be that in the shows a few years hence there will be animals far superior, in the excellence of their mohair, to most of those shown at Kansas City in 1901. There were a considerable number of goats, on the contrary, which were superior in many essential points—better individuals, indeed, than most breeders expected to see in the United States at this time. Thus it was, having very poor goats and very excellent ones on sale, that prices in the auction ring ranged from $6.25 for the cheapest does to $1,050 for the sweepstakes buck.

The prize buck Pasha Columbia brought the highest price, $1,050; a prize yearling buck from Lawrence, Kans., $510; prize doe American Princess, $275; a 2-year-old doe from Carlsbad, N. Mex., $250; and a 4-year-old buck from San Jose, Calif., $250. Other goats sold from $220 down to $6.25.

SWEEPSTAKES BUCK AND DOE.

No art of the photographer can show the best points of an
goat, but the picture of Pasha Columbia (Pl. XCII, fig. 1), t
sweepstakes buck, which sold for $1,050 in the ring at Kans
shows his size, general features, and length and thickness o
The mohair upon his throat and belly is as thick and long as tl
the sides. He is so nearly kempless that it is difficult to find
on him. He was bred and raised by C. P. Bailey & Sons Co.
Jose, Calif. The judges at the show found no difficulty in giv
the first prize in the sweepstakes class.

Pasha Columbia was purchased by Mrs. M. Armer, of K
N. Mex., after spirited bidding.

The sweepstakes doe American Princess (Pl. XCII, fig.
another animal from the flocks of C. P. Bailey & Sons Co.
first premium also in her class of 3-year-olds, and sold in
for $275 to Thomas H. Mastin, of Mastin, Kans. The pho
reproduced here, having been taken under cover, does not sho
best advantage; but her general appearance shows her to be a
of excellent points. Like Pasha Columbia, she is well covere
neck and belly with a heavy fleece, and she, too, is almost kem

JUDGES OF THE GOATS.

The judges of the goats in the ring were J. M. Stewart, o
town, Ill.; Dr. J. R. Standley, of Platteville, Iowa; Col. J.
Hoag, of Maquoketa, Iowa. George G. Emery, of Sanford,
a special judge on mohair on goats in pens, while George
Thompson, of Washington, performed this duty on goats show
ring.

ANGORA VENISON.

One feature especially in connection with this exhibition
was a banquet, at which the flesh of Angoras was served in
styles and at which no other kinds of meat were admitted.
purpose of the banquet was to popularize the use of this kind
and consequently many persons were invited to occupy seat
table who had never eaten it. There appeared to be no diss
the general opinion that Angora kid is equal in every respe

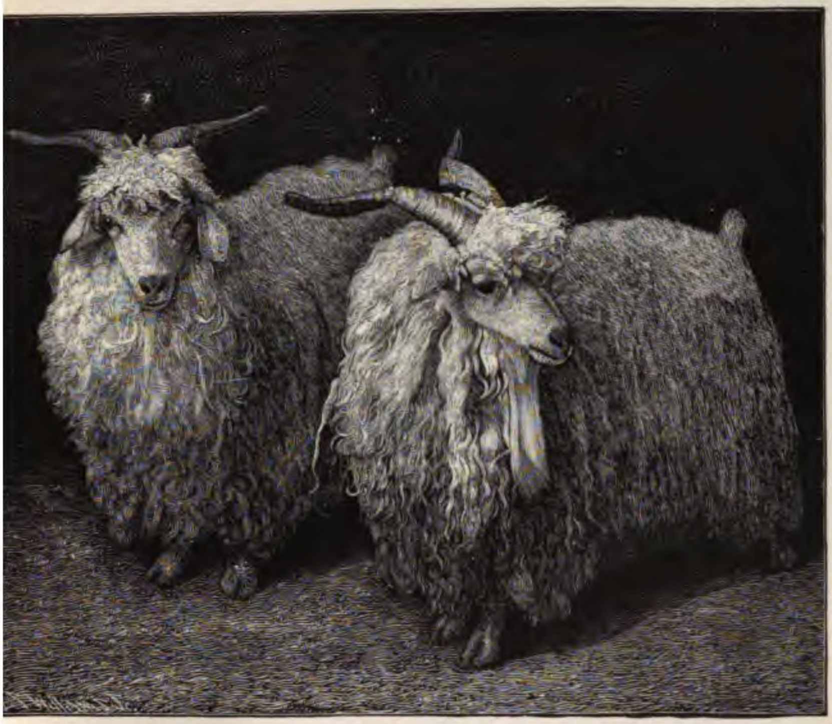


FIG. 1.—ANGORAS IMPORTED BY WM. M. LANDRUM.

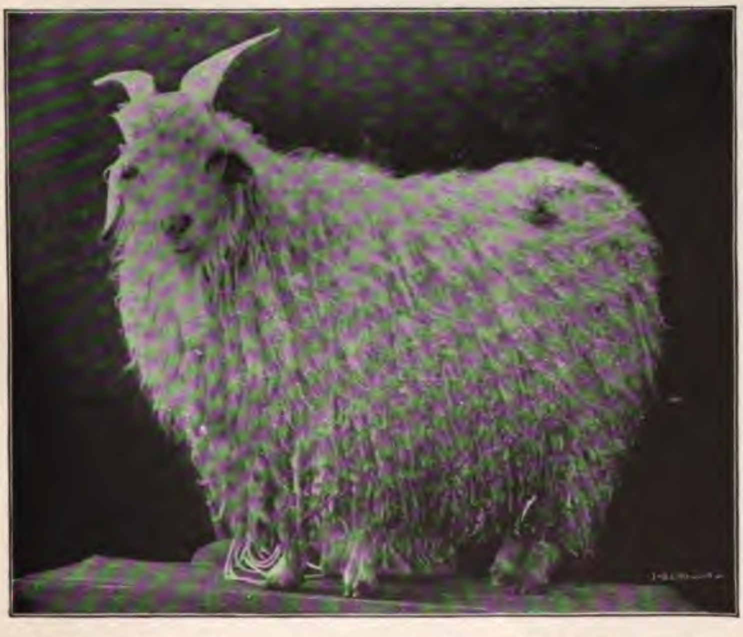
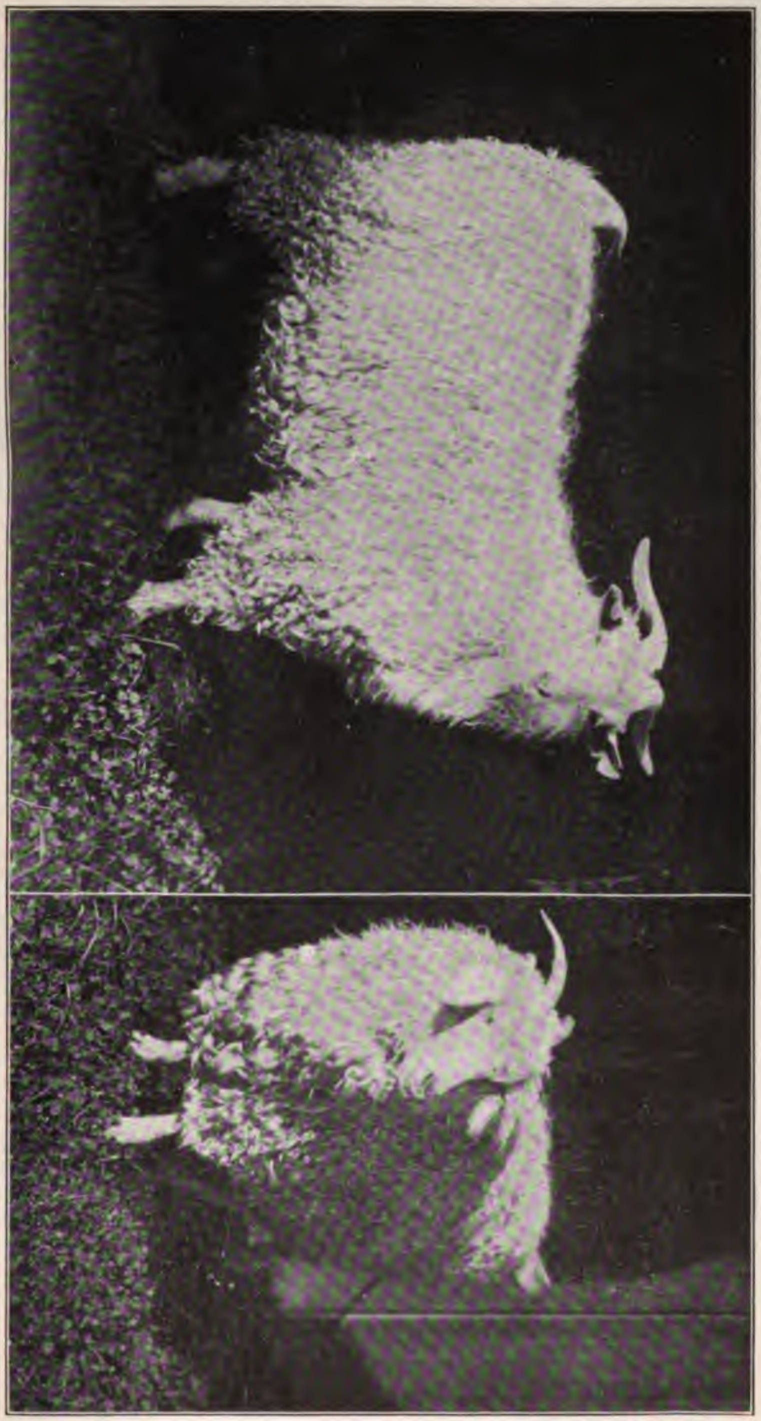


FIG. 2.—LAZARUS, SWEEPSTAKES BUCK AT KANSAS CITY SHOW IN 1900.

Illustration furnished by B. F. Richardson.



BAILEY IMPORTATIONS OF 1901.

Photograph furnished by C. P. Bailey & Sons Company.

As this industry becomes larger and larger there will be an increas- g number of Angora wethers which must be put to the most profit- le use. While it may be found that many of them will yield a profit mohair producers, it will be more economical to dispose of most of em for Angora venison. For this reason it is quite essential that all ejudice against them on this score should be overcome.

LICE ON GOATS.

A careful examination of most of the exhibits of goats at Kansas ty showed that nearly all of them were infested with lice. It is not difficult matter, as all goat men agree, to rid goats of this annoyance dipping them in any of the common sheep-dip preparations. The imals can not thrive to the best advantage when they are carrying a ece full of lice; sometimes the lice become so numerous as to cause e goat to lose flesh and finally to fail to produce a good quality of hair, or even to produce a kid, if the infested animal is a doe.

Goat raisers must learn that an animal which is badly infested with e in the winter nearly always requires extra feed; in other words, lice are raised, they insist on being fed.

RESOLUTIONS.

The association unanimously adopted the following resolutions, ich were introduced by Col. William L. Black, Fort McKavett, Tex.:

Whereas the hide, or skin, of the Angora goat is of great value, and can be largely d for the making of rugs and carriage robes, as well as overcoats for men and men; and

Whereas under present conditions of the United States tariff the skin of the Asi- c goat is allowed to be imported into our country free of duty if in a raw state, l at the low rate of 20 per cent ad valorem duty if dressed, which is not more than ents on a skin, owing to the low scale of labor in Asiatic countries; and

Whereas it is impossible for the American furriers of skins to compete with such rade: Therefore be it

Resolved, By the American Angora Goat Breeders' Association that Congress be quested to so revise the tariff, in respect to all skins that are imported into the ited States for the purpose of making rugs, robes, and clothing, so as to equalize e cost of producing and dressing the same with the cost to the American goat ser and furrier; and that the tariff be made "specific" and not "ad valorem."

Resolved, That a copy of the foregoing resolution be forwarded to the Hon. James ilson, Secretary of Agriculture, with a request from the American Angora Goat eeders' Association to use his best efforts in having the same favorably acted upon.

LETTER TO THE SECRETARY OF AGRICULTURE.

The following letter was sent to the Secretary of Agriculture by ection of the association:

KANSAS CITY, *October 28, 1901.*

e Hon. JAMES WILSON,
Secretary of Agriculture, Washington, D. C.

DEAR SIR: The members of the American Angora Goat Breeders' Association, at ir second annual meeting in Kansas City, Mo., desire to express to you their sin- e thanks for the generous aid which has been rendered them by yourself in the publication and distribution of literature concerning the Angora goat and its by-products, which they recognize as being the chief lever that has lifted this grand industry into the prominence which it enjoys to-day.

The meeting that has just terminated was attended by many hundreds of citizens from nearly every State in the Union, who showed the great confidence they had in the industry by a very liberal purchase of goats with which they expected to embark in the raising of the animal; and it is gratifying to state that the prices paid for the same were beyond the most sanguine, reaching in one case the phenomenal sum of $1,050 for a single animal and as much as $510 down to $250 for several others. And when we say to you that less than three years ago these very same animals would hardly have commanded as many cents some idea of the gratitude we feel for your able support and assistance may be imagined.

We believe the Angora goat industry has been established upon a permanent and sound foundation and will continue to grow very rapidly. If you will pardon us for invoking your valuable assistance once more, we would be pleased to lay before you a plan which we think can be employed to extend the uses of mohair very largely, and thus extend the usefulness of the Angora goat by utilizing the millions of acres of mountain and brush land in the United States that will probably never be employed for any other purpose.

It is well known that mohair possesses very remarkable strength and durability as well as being of a very light nature; and it has occurred to us that the fiber might be applied to the manufacture of army tents, sail cloth, and army clothing to much better advantage than cotton.

We would call your attention to the further fact that mohair is practically impervious to water, and that any fabric made from the same is proof against mildew, which is so destructive to all vegetable fibers.

It is our opinion that a sail and tent cloth can be made from mohair of equal strength and durability with that now made from cotton, which will be two-thirds lighter in weight, and that its life of usefulness will be three times as great, owing to its immunity from mildew.

In clothing for the Army, it is our opinion that a very light rain-proof coat can be made from mohair, which would be a great relief to many a foot-worn soldier on the march who is now compelled to carry a heavy cotton or india-rubber "slicker." And in the matter of transporting tents upon wagons, it will certainly be a great advantage to have them reduced to the extent of two-thirds their present weight.

Another valuable characteristic of mohair which makes it especially adapted to the making of army clothing is that it will not collect dust like cotton or wool.

If you do not differ with us in the foregoing suggestion, it will certainly be very gratifying to the members of the American Angora Goat Breeders' Association if you will use your influence with the proper officials of the United States Government to have the same put into practical operation.

Again thanking you for your very valuable support in the advancement of our young industry, we have the honor to remain,

Most respectfully, yours,

J. M. STEWART, *President.*
W. T. MCINTIRE, *Secretary.*

ORGANIZATION FOR 1901-1902.

The following officers were chosen for the association for the year 1901-1902:

President, J. M. Stewart .... Lewistown, Ill.
Vice-President, Wm. M. Landrum .... Laguna, Tex.
Secretary and treasurer, W. T. McIntire .... Station A, Kansas City, Mo.

irectors:

L. A. Allen	Station A, Kansas City, Mo.
Wm. L. Black	Fort McKavett, Tex.
W. C. Bailey	Station A, Kansas City, Mo.
R. C. Johnston	Lawrence, Kans.
C. S. Onderdonk	Lamy, N. Mex.
Horace A. Field	Wellsboro, Pa.
J. M. Stewart	Lewistown, Ill.
V. Marmaduke	Proctor, Mo.
J. Murray Hoag	Maquoketa, Iowa
W. J. Morgan, sr	Saginaw, Mich.
Wm. M. Landrum	Laguna, Tex.
J. R. Standley	Platteville, Iowa
John S. Harris	Salem, Oreg.

HISTORY OF PLUSH MANUFACTURE IN THE UNITED STATES.

Prior to the year 1881 practically all of the plushes which were used the United States were imported from two countries—France and rmany; and in no one plant in either of these countries was the cess of manufacture carried on from beginning to end. The mernt imported his mohair yarns from England. This yarn was made into warps and sent to a house which contained one, two, or more d looms, and woven into the fabric; generally the head of the house a son or daughter who assisted him, he throwing the shuttle and ting up the loom while the child pulled out the wires. The protion was from 2 to 3 yards a day, working from fourteen to fifteen rs. After a cut of, say, 40 yards are woven, it was then taken by weaver to the warehouse of the merchant, who sent it to a dyeing finishing establishment, after which it was ready for the market. t is only within a very short time that in France and Germany se goods have been manufactured on power looms in special facto-, and even to-day the mohair yarn is all made in England, but plant, instead of distributing the yarn as heretofore, now takes it their own factories, where it is woven, dyed, and finished.

eorge B. Goodall was the projector of the mohair plush industry Sanford, Me. He began experimenting in 1881, and with his own ds placed the first mohair warp in a wire-power loom, and it was who wove the first piece of plush. As soon as he had demonstrated t mohair plush could be made on a power loom, a company, comed of the three brothers—George, Louis, and Ernest Goodall—was anized for the purpose of entering upon this manufacture. A firsts inventor was consulted, and the perfect working wire-motion ver plush loom now in use at the mill was the final result. The pany started with one loom; they now have 125 in operation, with umber of new ones in process of construction.

he struggle at the beginning was one that would have discouraged ety-nine men out of a hundred. Weeks and months passed before iece of plush that could be termed perfect was produced, but pererance conquered.

As a result of the manufacture of car and furniture mohair on power looms, where the production was from fifteen to yards a day, the prices have been very materially lower in this try, and within six or seven years from the beginning of the facture prices were reduced fully 50 per cent.

Besides the Sanford Mills, mentioned above, the Massac Mohair Plush Company, at Lowell, Mass., as its name signifie ufactures plushes, having begun this line of work in 1892 several years these mills used imported mohair almost entirely, 1896, finding an improvement in the domestic product, they be use the latter very largely.

These facts of history are given place here to answer the frequently made whether mohair plushes are made in the States. The statistics of mohair consumption in 1899 show t mills consumed not only all of the domestic product but million pounds of imported mohair.

As the domestic supply increases and improves other mi consume much of it. Some do not use it at this time becau difficult to obtain a supply such as would warrant the purchase special machinery required.

PRODUCTION OF MOHAIR.

Bulletin No. 27 of this Bureau gave a statement of the pro of mohair in 1899, based upon reports from nine mills. The d product was then estimated to be 1,077,000 pounds. The effort were made this year to ascertain from the same sources the pro of 1900 and 1901 brought out the fact that some mills we using the mohair yarns only. These, of course, were counted mill making them from the raw material, and so can not p appear again. Other mills had discontinued their use for one or another until the supply was steadier and greater; until the for mohair goods, which was temporarily curtailed, should stronger; and so on. However, if the mohair upon the skins are put upon the market is not considered, the reports from th institutions named in the table give approximately the mohair tion of the United States for 1900 and 1901.

Mohair used in 1900 and 1901.

Mills.	Domestic.		For
	1900.	1901.	1900.
Sanford Mills	648,025	721,796	293,559
Massachusetts Mohair Plush Company	425,000	600,000	75,000
Cranston Worsted Mills	16,525	5,299	916
Total	1,089,550	1,327,095	369,475

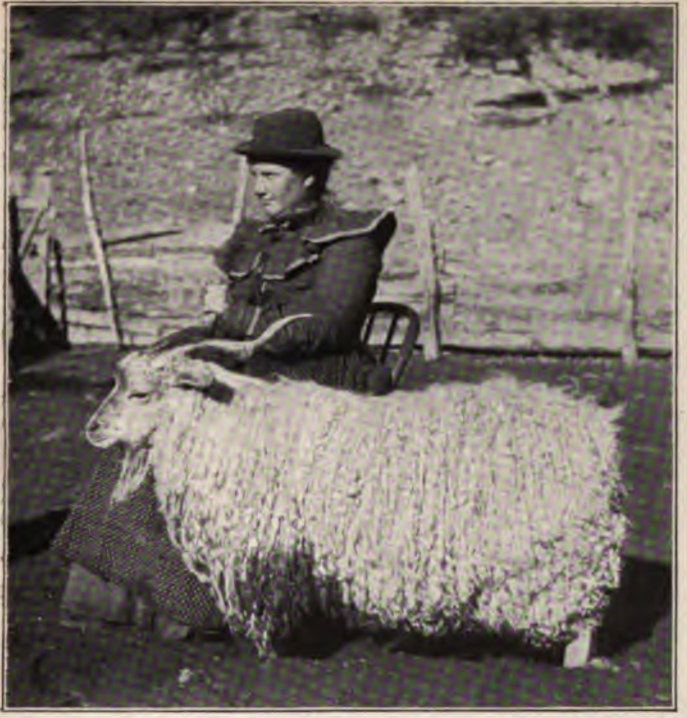


FIG. 1.—PASHA COLUMBIA, SWEEPSTAKES BUCK AT KANSAS CITY SHOW IN 1901.

Photograph furnished by Mrs. M. Armer.

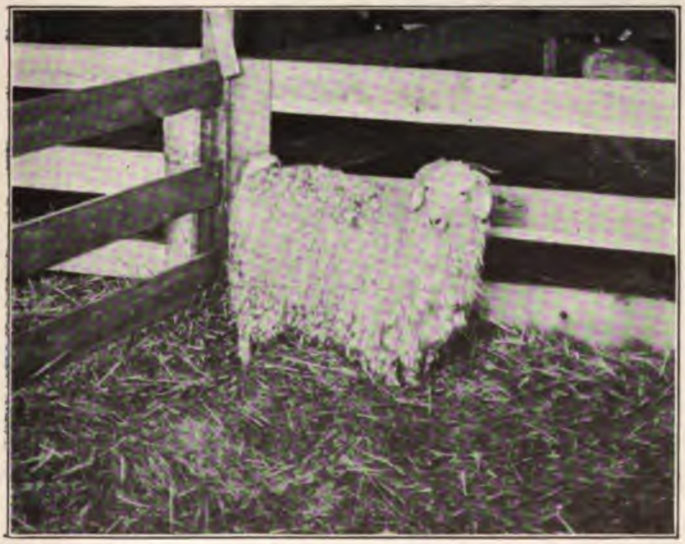
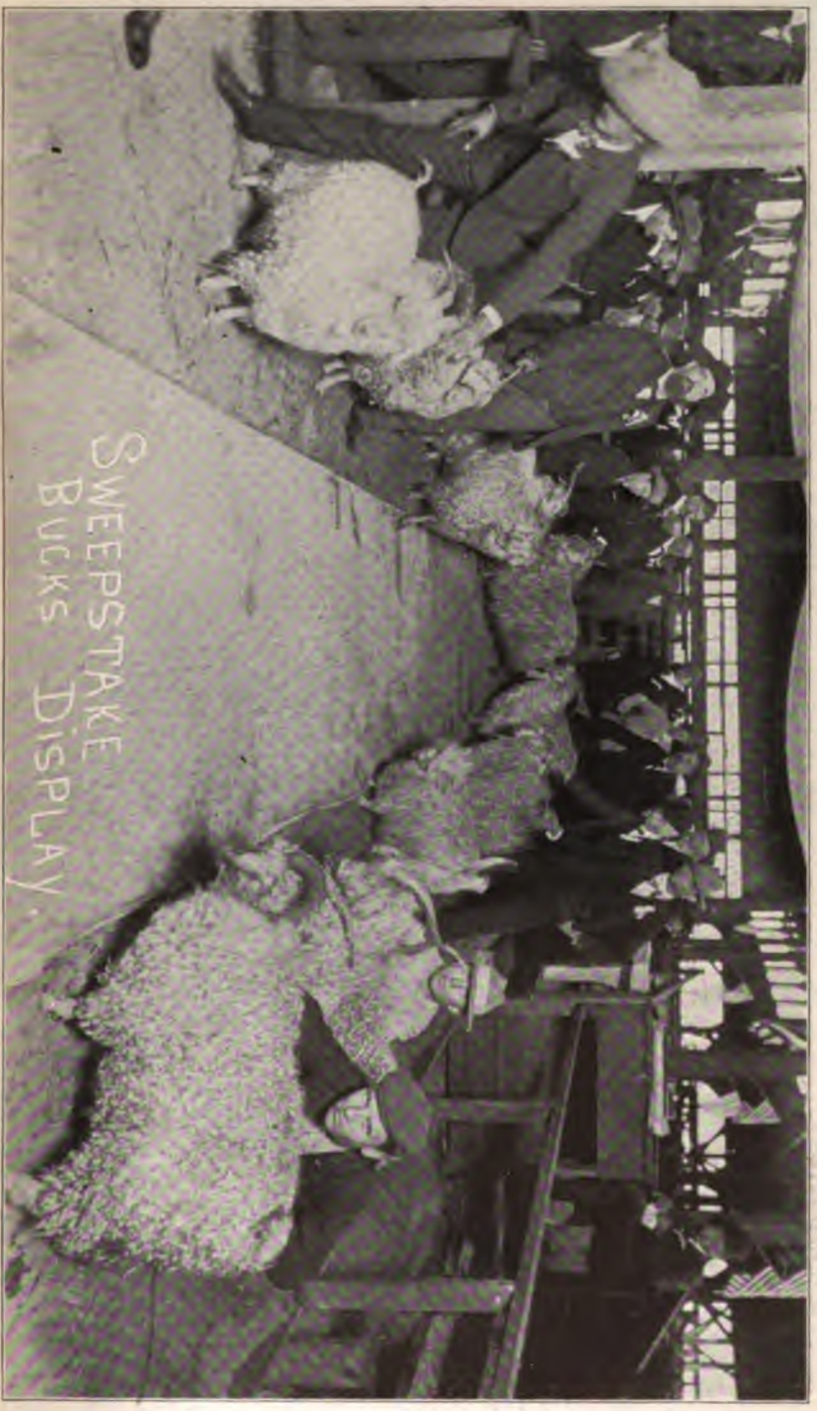
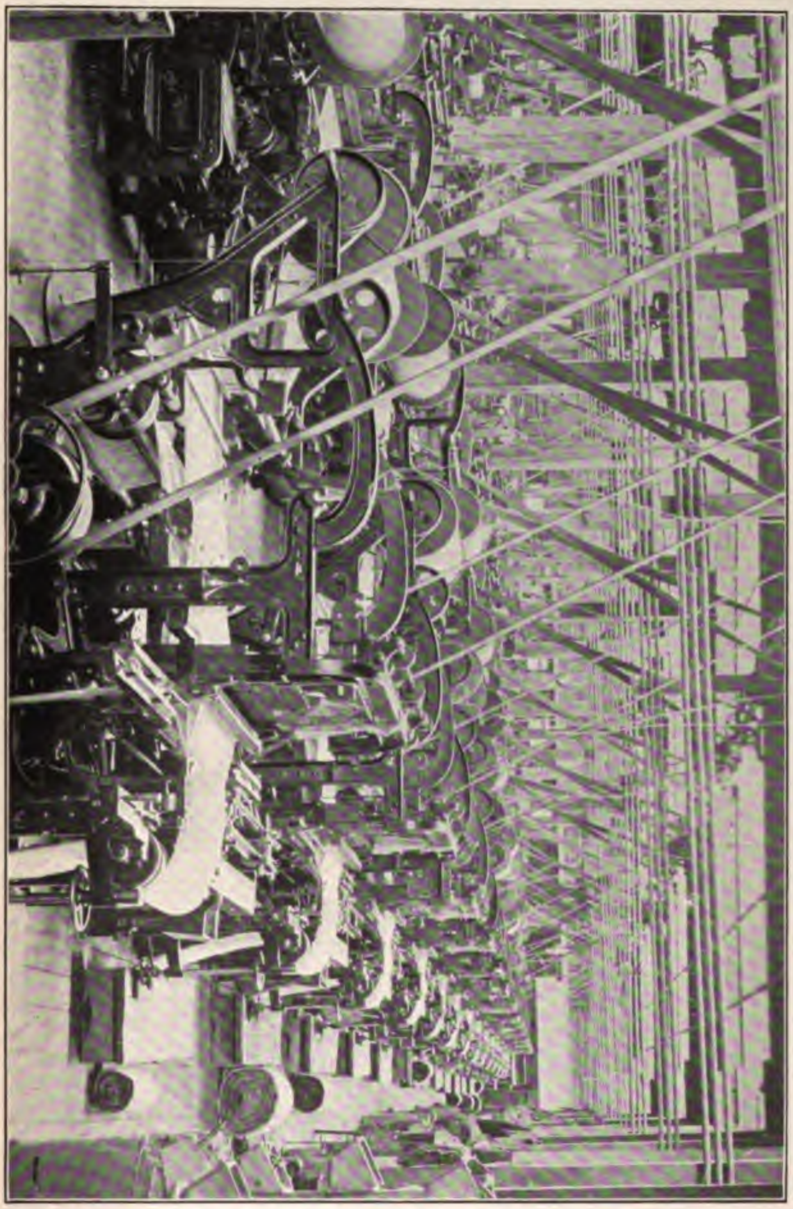


FIG. 2.—AMERICAN PRINCESS, SWEEPSTAKES DOE AT KANSAS CITY SHOW IN 1901.

Photograph furnished by John W. Fulton.



SWEEPSTAKES BUCKS AT KANSAS CITY SHOW IN 1901.



CORNER OF PLUSH WEAVE ROOM.

IMPORTS OF ANGORA GOATSKINS.

There has never yet been any report upon the number and value of Angora goatskins, separate from other goatskins, which are imported into the United States. The fact has been apparent to the careful observer that large numbers are imported, if we may judge by the number in use, for our own goat raisers are not yet placing a large number upon the market. An inquiry of the Treasury Department about these imports brought out the information that separate records are not kept of the different kinds of goatskins received at our ports of entry. The collectors of the ports of New York, Philadelphia, and Boston were then requested to furnish the imports for the past five years, if possible, and two of them have been enabled to comply with the request. The situation in the New York office was such as to render a special search of the records impracticable. This is regretted, for it is probable that the number of Angora skins received there is very large. However, the Bureau of Statistics of the Treasury Department will begin with the next fiscal year to make a monthly statement of the number and value of Angora skins received at our ports of entry, and hereafter the country may know how extensive is the consumption of these skins in the United States.

The statistics furnished by the collectors at Boston and Philadelphia, while accurate for these two ports, can only serve as a hint of the great number which we import annually.

Importations of Angora goatskins into the port of Boston from January 1, 1898, to December 15, 1901.

Date of entry.	Number of skins.	Weight.	Value.
1898.		*Pounds.*	
July	1,800	5,388	$574
August	750	2,292	244
1901.			
April	2,378	6,942	705
July	2,585	8,308	914
August	400	2,247	239
October	750	2,196	245
November	900	2,898	319
December	1,500	4,306	480

Importations of Angora goatskins into the port of Philadelphia from 1896 to 1901, inclusive.

Date of entry.	Pounds.	Value.
1896	706,571	$76,378
1897	716,343	86,841
1898	19,540	2,754
1899	1,113,974	152,601
1900	790,782	144,577
1901	430,458	62,707

MOHAIR AND MOHAIR MANUFACTURES[a].

By GEORGE FAYETTE THOMPSON,
Editorial Clerk, Bureau of Animal Industry.

PURPOSE OF THIS ARTICLE.

The purpose of this article is twofold: (1) To call the attention of the breeders of Angora goats to the weak points of their animals as mohair producers, with suggestions as to measures for improvement; and (2) to call the attention of people generally to the great beauty, durability, and comparative cheapness of mohair manufactures, with the view of encouraging a stable and more extensive use of these goods.

FLEECE OF THE ANGORA GOAT.

Mohair is the technical name for the fleece of the Angora goat. It differs from the wool of the sheep in that it does not have the felting properties of the latter. The felting property of wool is due to the presence of scales, or epithelia, which cover the fiber in much the same manner that scales cover fish. It is the felting property of wool which distinguishes it principally from other animal fibers. Mohair is a hair proper, being devoid of scales, and so is not successfully used alone in felt goods.

The fleece upon the goat is pure white, is exceedingly lustrous, and grows to an average length of 10 inches annually. It hangs in beautiful wavy curls, or ringlets, from all parts of the body, if the animal is of the best breeding. The average annual production per head of mohair is about 4 pounds. The grade of the goat has much to do with the weight of the fleece. The first cross of an Angora buck upon a common doe gives but a small amount of mohair, but the increase in quantity is notable as the crosses become higher.

In Turkey, in South Africa, and in most States of the Union, shearing is done annually, as with sheep; but in the southwestern part of the United States, where probably the greater number of the flocks are located, the goats are sheared twice a year. This practice is due principally to the long warm season, which causes the goats to shed if they are not sheared; but feeding and careful handling will do much to prevent shedding, even though the warm season may be severe and long. It is not infrequent that goats are found in the Southwest carrying an annual fleece, and occasionally there is one having a fleece of eighteen months' to two years' growth. The great mass of them, however, will drop the fleece if it is not sheared semiannually. Of course, these semiannual clips are much shorter in length than the annual clips, and therefore are not so valuable in the market. While the semiannual clips together average a little heavier than the annual clip, the difference is not sufficient to compensate for the added care and expense of shearing and the reduced price.

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[a] Also published in Yearbook of United States Department of Agriculture for 1901.

As just intimated by reference to the length of the clip, it is quality that gives to mohair its relative value. The manufacturers desire a long fiber, very fine, and strong. While there are uses for coarse grades of good length, the price is not so good as for the finer grades. The finer fleeces are produced by kids, wethers, and the younger does. The fleece of all Angoras grows coarse after the goats are six years old, beginning even earlier than this with bucks. The finer grades of mohair are used principally in the manufacture of plushes and the coarser grades in dress goods, coat linings, etc. Feeding has much to do with the length and strength of mohair as well as with the weight of the fleece. The colder climates also increase the fineness and add to the weight.

The following table, which is compiled from a "Report of examination of wools," etc., by Dr. William McMurtrie, and published by the Department of Agriculture in 1886, gives a very interesting comparison between length, fineness, strain and stretch of mohair and commercial grades of wool:

A comparison of mohair and wool fibers.

Description.	Length.	Fineness.		Strain.		Stretch.	
	Inches.	*Centimillimeters.*	*Thousandths of inch.*	*Grams.*	*Grains.*	*Millimeters.*	*Per cent.*
Mohair (average of 480 tests)..	6.91	3.157	1.2429	19.12	295.11	10.60	26.50
Commercial wools (average of 1,410 tests)	2.62	2.118	.8352	7.01	108.79	5.02	25.11

It will be observed that mohair is not equal to wool in fineness, but in strain there is a difference much greater than would be suggested by the larger fiber. The average wool fiber in these tests stood a strain of 108.79 grains, while the average mohair fiber stood a strain of 295.11 grains. This is a difference of 186.32 grains—much more than double the strength of wool. It is to this strength of fiber that the great durability of mohair goods is ascribed. In stretching quality there is but a slight difference between mohair and wool. Dr. McMurtrie makes the point in discussing wools that the individual fibers may be variable in size, a condition brought about, it is supposed, by sudden changes in weather or feed, or by ill health. Dr. McMurtrie's remarks on this question are applicable to mohair, and so are copied here somewhat extensively:

> In the study of the wools constituting the collection under present examination, one can not avoid being struck with the lack of what the German authorities term

Evenness Treue, or uniformity in the diameter of the fiber throughout its length; and this property is probably one of the most important, if it does not even stand first, in the determination of the commercial and industrial value of the staple. It is the result of two causes—the one atrophy of the fiber at certain parts, the other hypertrophy. In other words, when we examine a sample of uneven staple with the microscope, we notice a greater width of the images at some parts than at others, and these variations are by no means wanting in interest, nor are they absent in many of the animals said to have received excellent care and feed. In some cases we find a sudden contraction of the fiber at certain points (atrophy), and this is often sufficient to give the edge of the image a decidedly notched appearance. In other cases the contraction is more gradual, the progressive diminution of the width of the image extending over a greater length of the fiber. In the enlargement, however (hypertrophy), such sharp variations do not obtain; the fiber begins to enlarge at a certain point, and the enlargement may continue through the length of the fiber until it attains a diameter even twice as great as at other parts. * * *

Where atrophies occur the fiber must necessarily be weakened, while, on the other hand, staples in which the atrophied fibers occur in any important proportion must interfere with the regular passage of the material through the several machines and processes of the factory. In both cases, therefore, they seriously impair the value of the products, and it behooves growers to look to the causes which may have a tendency to bring them out. What these causes may be we have had no opportunity to determine, but there can be little doubt that bad nutrition, exposure, and consequent impaired health or constitution are the more prominent. A fevered condition of the system probably tends to check normal exercise of the functions of the skin, and hence the growth of the fiber resulting in atrophy, or it may have the contrary effect and cause hypertrophy. * * * We have sufficient evidence to show that when animals have been well fed and cared for, and when the health of the animal has been uniform, such deformities in the fibers do not exist. And that the growth of the wool is retarded, or at least that the diameter of the fiber is diminished by impaired health of the animal is well illustrated in the following bit of our own experience. On one occasion a prominent breeder of Merino sheep submitted a sample of his wool for the determination of its fineness. By the system of measurement followed we found that the fibers were finer at a certain part or point in their development than at others, and by simple calculation it was easy to determine at what part of the season the finer portion of the staple had developed. We stated that at that season the animal must have been in ill health, and this was afterwards confirmed by reference to the record of the condition of the different individuals of the flock during the year. And it further illustrates the importance of great care in the management of sheep and the value of protecting them from any sudden changes, and from the inclemencies of the weather in general.

All mohair has a luster peculiarly its own, but this is much more pronounced in some fleeces than in others. That having the higher luster, other qualities being equal, commands the better price. A fleece of low luster indicates a goat under influence of adverse conditions—as poor breeding, poor feeding, or sickness. The uninformed often express the opinion that this luster is due to oil in the fleece, but this is erroneous. Whatever oil there may be in mohair is inside the individual hairs, and not on the outside, as in the case of wool. A mohair fleece may be washed, then scoured, and then steamed, dyed, and worked up into fabrics after reaching the mills, but none of these processes removes any of the luster; indeed, all of them operate simply *to intensify* it.

PRESENCE OF KEMP IN MOHAIR.

It is a fact well known to breeders that the Angora goat has two coats of hair. The outer and more abundant coat is the mohair, while the under coat is a coarse, chalky white, straight, stiff hair, varying in length from one-half to 4 inches. This under hair is known by the name of kemp. It is generally believed to be the relic of the common goat blood in the Angora, for it is a matter of history that the Angora flocks of the United States, as well as those of Asia Minor and South Africa, have been largely increased by crossing upon the does of common blood. This has been done to such an extent, indeed, that it is no longer contended that there remain any Angora goats of absolutely pure blood. This disbelief in pure blood is based upon the fact that the first cross of an Angora upon a common doe yields a fleece in which kemp largely predominates, and that as the crosses become higher the quantity of kemps grows less. That point has not yet been reached, however, where it can be said that a strain has been produced which has no kemp whatever, although a few breeders in this country and in South Africa appear to have very nearly reached that very desirable result. This is the principal end to which breeders should lend their best efforts at this time. It is the most difficult quality to obtain. Length, strength, fineness, and luster may all respond readily to the intelligence of the breeder, but kemp is stubborn. The hope is confidently expressed by the best breeders that a strain of Angora goats will yet be produced which will be entirely free from kemp.

The spirit of the goat men who met in Kansas City on October 24–28, 1901, in attendance upon the meetings of the American Angora Goat Breeders' Association, showed that they were not only willing but anxious to undertake the solution of this problem. While all these men were familiar with kemp and knew that it was a deleterious feature of mohair, not many of them knew before this meeting was held how objectionable it really is to the manufacturer, and consequently how much it tends toward keeping the price of mohair low.

At Kansas City the mohair producer and the mohair manufacturer met each other for the first time in this country, the presence of both being in the interests of the Angora goat industry. George G. Emery, of Sanford, Me., addressed the association on three occasions during the week, his theme each time bearing upon the quality of fiber required by the manufacturer. He displayed a large assortment of goods, using them to supplement his argument concerning the uses and value of good mohair as compared with the poorer grades. The writer of this article, representing the Bureau of Animal Industry, also addressed the association along the same lines. The goat men showed a disposition to learn all that is required by the manufacturers, and determined to redouble their efforts toward a higher standard for their flocks. The large price of $1,050 was paid for the buck Columbia Pasha at the Kansas City goat show, principally because of his freedom from kemp. It is true that his fleece was fine and long and his body was fully covered, but the appearance of the animal as he stood in the pen (his size and carriage), although he was a "good looker," had comparatively little weight with the judges, who gave to him the sweepstakes prize as the best buck of all ages in the show.

WHY KEMP IS OBJECTIONABLE.

The reason why kemp is objectionable is that it will not take the dyes used for mohair; the only effect of the dyes is slightly to discolor the kemp. There are dyes, it is true, which act upon kemp, but they have no effect upon mohair; and the best efforts put forth have not yet resulted in a mixture of dyes that will act satisfactorily upon both mohair and kemp at the same time. The only solution, therefore, is to remove kemp from fleeces which enter into the manufacture of fabrics in which it is undesirable.

Kemp appears in its worst phase in plushes, where every individual hair shows prominently. Its presence here is much more pronounced than when in the fleece, where it is nearly of the same color as the mohair. It is therefore of great importance that this objectionable substance should be removed from the fleeces. If any kemp should escape the eye and be woven into the plush fabric it would not be discovered until the fabric came from the dye, for it must be remembered that mohair plushes are woven "in the white," and afterwards (perhaps several months or a year) are dyed according to instructions to fill orders. Kemp, at this stage of the process, becomes an expensive proposition, for skillful hands must burl out every fiber of it as well as every other bit of foreign substance. In the cheaper plushes, such as are largely used in street cars, there is a considerable quantity of kemp. Much of this material may also be used without detriment in the manufacture of rugs.

The problem of the mohair manufacturer is the same as that of the mohair grower—how to get rid of kemp; and the burden of his meditations is to devise some sort of machinery that will do the work perfectly. American ingenuity has so far failed to invent such a machine; and so the manufacturer finds it necessary to call upon the breeder to produce mohair without kemp. The solution of the problem, therefore, appears to be with the breeder rather than the manufacturer.

But the fact remains that the mills must get rid of kemp in some way, and the device which they use for the purpose is a machine which combs it out; but while the comb is removing the kemp it removes at the same time every mohair fiber of equal length with the kemp. This means that if the mohair going into this comb has kemp 3 inches long all mohair fibers up to 3 inches in length must go out with it. The result is heavy loss. True, there is a use for this mixture of kemp and short mohair, as heretofore stated, in the manufacture of cheap goods, such as horse blankets and filling for carpets, and also for stuffing saddles, and it has a value ranging from 7 to probably 10 cents per pound. From the breeders' standpoint this residue from the combs will be considered as a loss, and he must figure it as wastage. This wastage runs from 5 to 40 per cent. It is eminently proper to quote here the opinion of one who has spent many years in fabricating mohair, namely, George B. Goodall, of Sanford, Me.:

> A majority of the mohair growers in this country little realize how much kemp has to do in keeping down values of their clips. If they could spend a few hours in our sorting and combing rooms, the lesson learned would be of great value to them—more than could be obtained by reading. In watching the combs at work they would notice some making 5, 10, or 12 per cent of noil or waste, while others will be taking out 30 or 40 per cent. Ask the comber the reason of this, and he will reply that one lot has a much larger amount of kemp than the other. One fiber of kemp takes out five or six good fibers which should go into yarn.

The thought has probably already occurred to the breeder that the longer the kemp the greater the wastage. But how can kemp be shortened? is the question of importance next to getting rid of it altogether. It is generally accepted as a fact that long kemp is evidence that the animal producing it is bred up from long-haired Mexican does, while short kemp is a relic of short-haired does, such as are quite common in suburbs of large cities. If this be true, the point is already made that, in building up a flock from common does as the foundation, none but short-haired ones should be used.

Let it be said in passing, however, that there are so many thoroughbred and high-grade Angoras in this country now that the reason or necessity for crossing upon common goats does not exist as it did several years ago. To continue the practice is to continue the injection of kemp into Angora blood. The crossing upon common stock has been done with the double purpose in view of increasing the flocks more rapidly and of infusing stronger blood into the Angoras. As stated above, the necessity for the first is probably past; with regard to the second, it can be said that there are now in the country strains of Angoras which are as large and vigorous as any common goats may be. These might be used to impart constitution to the delicate flocks.

Finally, concerning kemp, its presence in mohair is not objectionable on the score of durability, for it has lasting properties, but its coarseness and its inability to take mohair dyes make it undesirable.

DURABILITY OF MOHAIR.

The durability of mohair and mohair manufactures is well known to those who are familiar with their use. Statements which to some may seem incredible are on record, but there is no good reason to doubt their accuracy. S. Holmes Pegler, author of the excellent English work, "The book of the goat," states that in 1881 the Duke of Wellington imported a half dozen Angoras from the Cape, and many of the clothes worn by the duke were from the fleeces of these goats, and he continues: "I myself possess an overcoat cut from the same stuff, presented to me by his Grace, which promises to be everlasting as regards wear." Dr. James B. Davis, who first introduced Angoras into the United States, having himself brought them from Asia Minor, says in an article which he published in the Annual Report of this Department for 1853: "I have socks which I have worn for six years and are yet perfectly sound." A friend of the writer states that he has had one mohair rug at his office door for twelve years, and it does not yet show much wear, while the luster and color remain as distinct as when new. Ladies who have worn mohair crepons and brilliantines are all aware of the wonderful durability of this fiber.

Strange as it may appear upon first thought, it is the durability of mohair dress goods that has prevented their more extensive use heretofore. The first cost being somewhat high, they have not generally been worn by people whose principal aim is durability in the purchase of clothing. They have been subject to the caprices of fashion, being "all the style" one year and "out of style" the next. This has naturally restricted their use largely to that class of people who could afford to discard them before wearing them out.

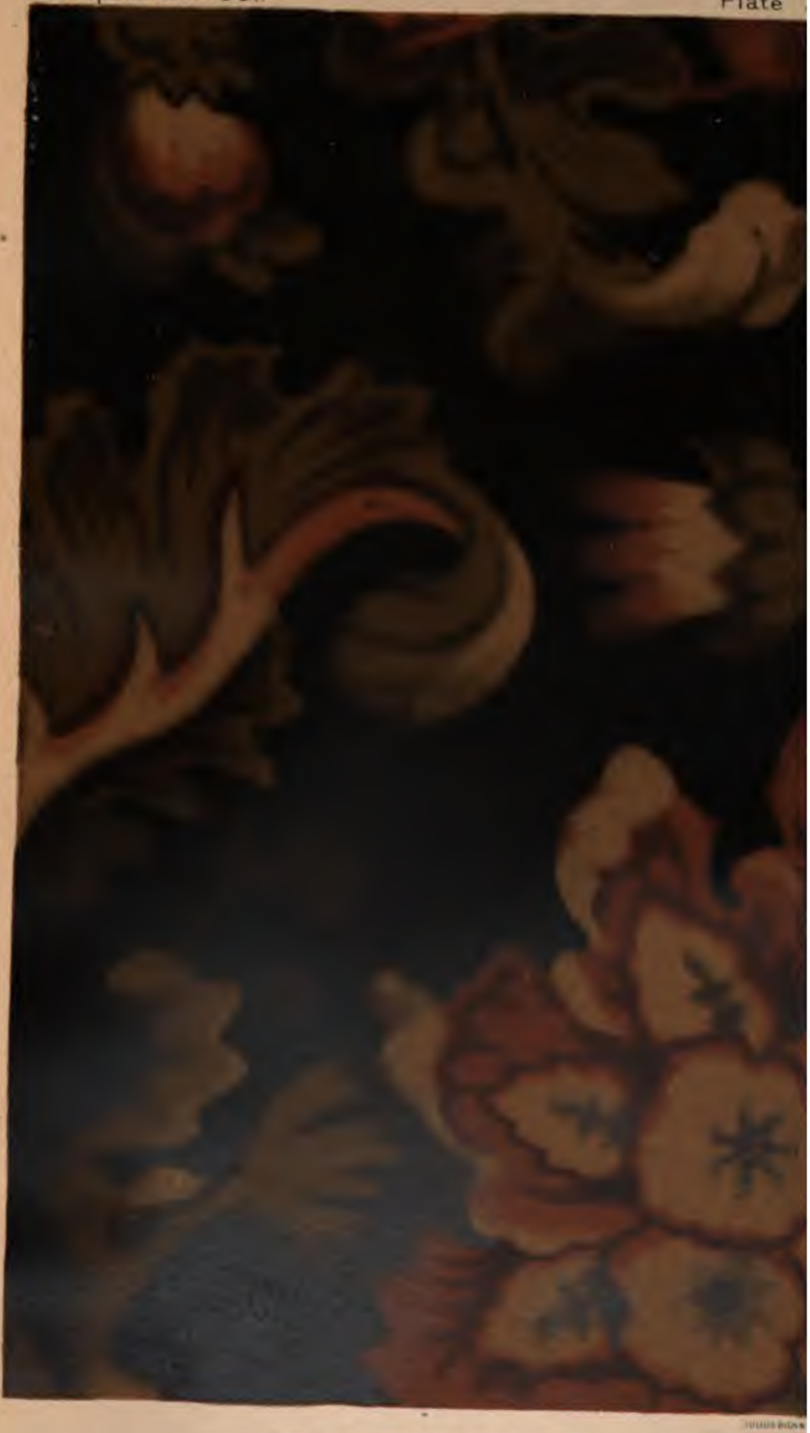
Even though the first cost of these goods may be high, their use would prove economical for that class of people who desire good quality and good appearance without affecting the highest degree of fashion. They will preserve their color to the last and the luster will never disappear.

INFLUENCE OF FOOD AND CARE OF GOATS ON FIBER.

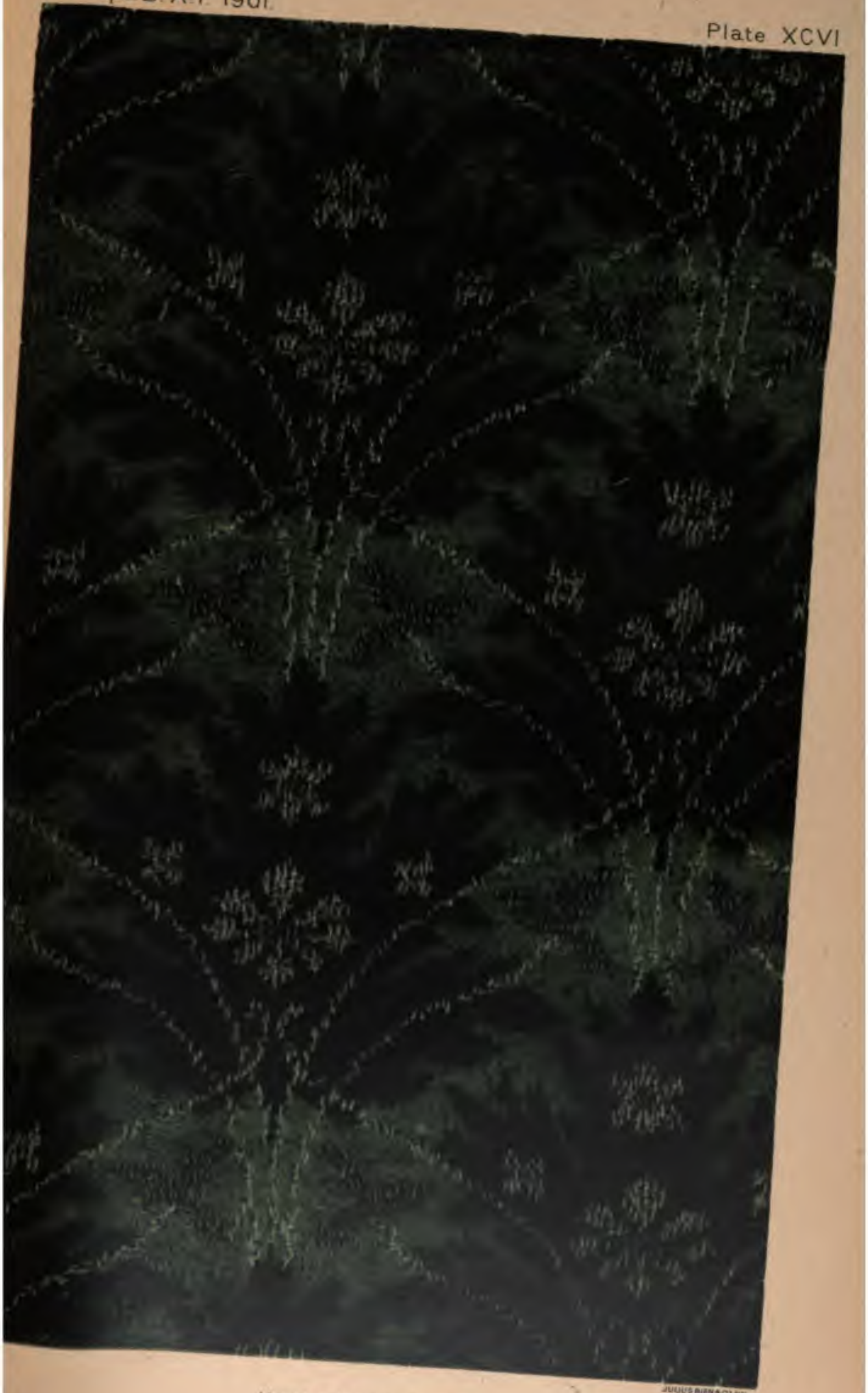
Any wool grower knows that feed and care have a very great influence upon the weight and fineness of the fleece. The same is applicable to mohair growing as well. If goats are exposed to sudden changes of weather, the effect is shown in the fleece. Under adverse conditions an individual mohair will show contractions, which greatly reduce its "stretch" and "strain." This point is fully covered in the quotation from Dr. William McMurtrie, on page 481, and need not be further mentioned here.

John S. Harris, one of the early breeders of Angora goats, and who is a man of good observation and rare judgment, says that the finest and evenest mohair is from goats which feed upon grass. He says that brush is "pie" to goats, and a little pie will do no harm; but all pie is not good. While this is contrary to the opinion of most breeders, the experience of one who has so long been raising goats should *not* be hastily cast aside.

HAND-PAINTED MOHAIR PLUSH.



HAND-PAINTED MOHAIR PLUSH.



JULIUS BIEN & CO. N.Y.

MOHAIR FRIEZE PLUSH.

S. C. Cronwright Schreiner says:

> If goats are to produce the best fleeces they are capable of they must be maintained in uninterrupted good condition. They must have a variety of food, principally shrubs and aromatic plants, and lead an active life; they must, if possible, have running water to drink, and be kept free from dust; they must not be kraaled (or shedded) except when absolutely necessary; they must have clean sleeping places, and must not be crowded together.

It is the opinion of the writer that the many important points concerning the length, strength, and fineness of fleeces should be the subject of scientific experimentation, which experimentation should include the effects of feed and climate. The results of an investigation of this character would answer as well for the sheep industry of our country, with its annual wool production of 289,000,000 pounds, as for the growing mohair industry, for the same conditions govern with both fibers.

PRICES OF MOHAIR.

A long chapter might be written about the reputed prices obtained for mohair during the first few years after the introduction of Angora goats into this country; but as there were no mills in this country at that time which were able to fabricate the fleeces, and as the quantity of mohair produced was very limited and of uncertain quality, and as there appears to be no definite data available of sales made at the enormous prices which are sometimes referred to, it would seem that no useful purpose will be subserved by discussing the prices of that period. Attention will be given, therefore, to the prices of the present, for these are the prices which interest the mohair growers of to-day.

What has been said in previous paragraphs about varying qualities of mohair has no doubt suggested the thought that prices also are very variable, which is true. It is not the quality alone which affects the price, but supply and demand, which affect all articles of commerce, play a very important part. It was decreed by Dame Fashion last year, for instance, that mohair dress goods were not in style, and the effect of this decree was to reduce the value of mohair. Other causes, a principal one of which was a very limited demand for car plush, also contributed to the cause of low prices.

To give a brief answer to the question, What is mohair worth? is not possible. There are more grades of mohair than there are of wool, and there has so far been no effort on the part of mohair producers to so sort their fleeces as to enable them to receive the highest price for each class, but they have been content to sell it in one mixed lot. This always tends to reduce the price below its real worth, because the purchaser, not knowing exactly what he is buying, protects himself with a low price. The features that make for low prices are shortness and coarseness of fiber, and the presence of kemp, burs, and dirt of all kinds. There were on exhibition at the Kansas City show some fleeces which looked as if they might have been raked out of a filthy hogpen; these had been sold at 7 cents per pound, while other fleeces in the same exhibit were worth 40 cents per pound.

Probably the average price paid for mohair during the past season was about 25 cents per pound. The product of the lower crosses, which contains a large percentage of kemp, brings a low price (10 to 15 cents), while there were some fleeces that brought 40 cents. There is not a large quantity of this latter quality of hair produced in this country, for the reason that the breeders have not given the matter proper attention. There is a great demand for the better hair, while the lower grades, which enter into the manufacture of carpets and horse blankets, find direct competition in wool.

While on the subject of prices, we will quote from a recent address by George G. Emery, of Sanford, Me.:

> I have read where prices as high as 45 cents per pound have been paid this season for domestic mohair. Now, such statements should be followed by an explanation, otherwise false hopes are apt to be raised in the minds of the growers, which hopes, in my opinion, are not to be realized. I can take any bale from among the hundreds sent us yearly from the State of Oregon (and the same applies to the twelve months' growth Texas hair; in fact, in any State producing mohair to-day), and I can find mohair which is worth 45 cents per pound and even more, but the percentage of the low grades, worth from 18 cents to 20 cents, is so much greater and so far overbalances the fine as to bring the value as a lot to a much lower figure. I have seen some very choice domestic mohair, but the amount of such hair is very small when compared with the total production of the country.

Prices in the Cape of Good Hope have ranged about the same as in our own country.

The great mohair manufacturing center of the world is Bradford, England, and as it will be interesting to many to see the prices which mohair has brought in that city during a long series of years, the following table is prepared from data compiled from the Bradford Observer by the National Association of Wool Manufacturers:

Range of prices of mohair at Bradford, England, from 1856 to 1894.

	Cents.		Cents.		Cents.
1856	48 to 56	1869	86 to 88	1882	38 to 45
1857	56 to 66	1870	92 to 98	1883	40 to 43
1858	60 to 72	1871	78 to 84	1884	37 to 45
1859	72	1872	82 to 90	1885	28 to 36
1860	76	1873	72 to 80	1886	23 to 32
1861	76	1874	70 to 90	1887	25 to 29
1862	72 to 78	1875	82 to 92	1888	24 to 28
1863	80 to 88	1876	86	1889	25 to 42
1864	78	1877	60 to 70	1890	27 to 36
1865	70	1878	60 to 66	1891	24 to 28
1866	80	1879	36 to 54	1892	24 to 29
1867	66 to 90	1880	42 to 54	1893	24 to 37
1868	58 to 76	1881	38 to 42	1894	27 to 31

But what of prices in the future? This is the important question with the breeder, and it is one that is difficult to answer. It seems likely that there will be an increasing demand for mohair in the classes of goods which now consume it, to say nothing of the new uses that may be developed; hence it may be expected that the demand will be strong. On the other hand, there will doubtless be an increased production, which will have a tendency to lower the price. There are so many uses for mohair already established in the world that it is not believed that prices will ever fall to a level with wool. One prominent manufacturer of mohair goods expresses the opinion that the "average prices paid this year [1901] can be considered as a low-water mark." This was about 25 cents a pound, as stated above.

The American Wool and Cotton Reporter states that with an increased production of Angora goats in this country, and the consequent enlarged production of mohair, the latter is going to be consumed more largely than heretofore, and is, indeed, already "cutting more of a figure in the wool market." The domestic product is favored by a tariff of 12 cents per pound on the imported article.

CARING FOR FLEECES.

It may not be known to goat breeders generally that the objection to any foreign fibers in mohair is the same as that which holds against kemp, namely, they will not take the mohair dyes. Therefore, if every particle of such foreign substance is not removed before going into the fabric, it shows in a prominent and unpleasant manner when the article is dyed, and necessarily cheapens it if it can not be burled out. For this reason mention is made here of the practice, quite general in this country, of tying fleeces with twine. In removing this twine at the mills it is almost impossible to prevent portions of it from adhering to the fleece, and it must be removed so far as possible by the most painstaking care. Fleeces from Turkey and Cape Colony are not tied, but simply rolled up inside out, and this is the condition in which the mills desire to receive them.

Goats should be washed before shearing, in the manner that sheep are washed, for much dirt will thus be removed, and the value of the fleece greatly enhanced. After the fleece is taken from the goat, it should be spread out upon a clean table, where all foreign substances may be carefully removed. While this procedure is tedious, and to some may appear useless, it will pay; for the work must be done on the farm or at the mill, and farm labor is not so expensive as mill labor.

MOHAIR MANUFACTURES.

The first striking feature of mohair manufactures is their great beauty. The luster of the hair, which is so pronounced even while it grows upon the goat, remains in the manufactured goods, and no amount of washing and no character of dye will remove it. It aids the dyes to show their colors more effectively, and imparts to the goods the pleasing property of changing shades in shifting lights, which is a feature quite characteristic of silk goods.

A second feature of importance is that the dyes are usually fast, and however much such goods may be exposed to the elements they will not fade. In the best mills fugitive dyes are not used except when an order is received to match a sample which has been treated with such dyes; for a fugitive dye can not be matched by a fast one, nor can a fast dye serve for a fugitive one.

The durability of mohair goods has been quite fully discussed in connection with the durability of the fiber composing them. It is a characteristic that ought to make their use economical in many ways. This should be the case especially with dress goods and other wearing apparel.

Mohair manufactures already have a very extensive use, but they appear in the stores under so many trade names that only a few people, comparatively, know that they are the product of the Angora fleece. These manufactures are so varied, and the fiber adapted to so many things which are now made of wool or cotton, that no attempt will be made here to give a complete list of them, but a recital of some of the principal uses of mohair goods will be made, in order that it may become generally known how extensive is their use at the present time, and some idea formed of the possibility of extending the use of mohair to other lines of manufacture.

By far the most important product of mohair manufacture is plushes. It is a fact not generally known that practically all of the plushes used in railroad passenger cars are made of mohair; so also are the plushes used in street cars. How much is used annually in the passenger cars of our country can only be conjectured. The report of the Interstate Commerce Commission for the fiscal year of 1899 shows that there was an increase of 244 cars over the previous year; let us add to this a number to take the place of those worn-out, which probably can not be less than 200, thus giving a total of 444 new passenger coaches each year. Each coach requires at least 120 yards of plush, and the total quantity required for the 444 cars would be 53,280 yards. This is an underestimate rather than an overestimate. During the year mentioned there were in service in the United States 16,785 first-class passenger cars, 3,063 second-class cars, 4,206 combination cars, 464 parlor cars, and 488 sleeping cars—total 25,006. This means that there were in use that year 3,000,720 yards of plush. Add to this all that is used in street cars, omnibuses, etc., for which there is no basis for an estimate, and we may conclude that its use for such purposes is enormous.

Besides the car plushes, which are usually plain, large quantities of frieze and crush plushes are used in upholstering furniture. The designs for the frieze plushes are limited only by the ingenuity of man. The skill of the fabricator is so well developed that the threads forming the designs are in loops and of different color, yet the whole is woven at one time "in the white" and afterwards colored in the same dye. The crush plushes are very handsome, showing to best advantage the effects of varying lights upon solid colors. This kind is largely utilized in upholstering armchairs, but finds large use also in other kinds of furniture (Pls. XCV and XCVI).

The carriage robes, couch covers, sofa-pillow covers, and rugs are distinguished by their high pile and rich coloring. The pile upon the carriage robes and sofa-pillow covers is about half an inch high. The robes sometimes have the pile on one side only, but many are made with the pile on both sides. The coloring is most exquisite, as is true of the sofa-pillow covers and couch covers. These colors are printed on by hand after the pieces are woven, and are rendered indelible by long steaming. Rugs necessarily require more modest covering, but all the richness of subdued colors and luster remain to make them a distinctly beautiful as well as useful ornament. These goods have not long been upon the market, but they can hardly fail to attract attention and advance in favor.

Most of the so-called astrakhan now in use so extensively is made of mohair. It has all the beauty of the real article, is much more durable, will never change its shade in sunlight or air, and is in no manner inferior to real astrakhan.

This Bureau has been furnished with samples of plain mohair dress goods (brilliantines), as well as mohair crepons, which are common and well known for their durability. There is no other kind of cloth which is more easily cleaned or which retains its newness for a longer period. For this reason brilliantines are especially popular for traveling dresses. Mohair crepons are more beautiful, but also more expensive, costing from $1.25 to $5 a yard. The cheaper grades are woven upon a cotton base, and go to pieces sooner than when woven upon a wool base. In crepons there is sometimes an admixture of silk.

It would be very difficult to enumerate the many ways that mohair might be used in manufactures. Besides plushes, which form the principal item, there may be mentioned dress goods of various designs, coats and coat linings, table covers, knit mits, mittens, gloves, etc., which are already on the market. It has been found that mohair cloth is the only kind that will stand the strain in the expressment of cottonseed oil, and there is a growing demand for it for this purpose. A suggestion has recently been made that mohair could be manufactured into tent and sail cloth and rain coats, having as its qualifications durability, lightness in weight, and immunity from molding. Mohair cloth will not only turn water, but will hold water like a skin if the water is not beaten through it. A piece of brilliantine in the form of a bag and holding a glass full of water hung all day in this office and not a drop passed through it during that time. Mr. John S. Harris recently informed the writer that he possessed mohair cloth 40 years of age which would hold water in the same manner. Tent and sail cloths would necessarily be heavier, and be even more effective in turning water. It is argued that the extra cost of this kind of cloth for these purposes is more than compensated for in the matter of durability and lightness of weight.

THE SKINS.

Ordinarily one would not expect to find a discussion of Angora goatskins under the general subject of mohair manufactures, but in consideration of many of the special uses to which the skins are put, because of the mohair rather than the skin to which it is attached, it seems proper to discuss the matter here.

The skins of the Angoras, if taken when the hair is about 4 inches long, make very handsome rugs. The hair retains its original luster, and may be used in the natural white or dyed any color desired. The pure white ones are more generally preferred. There is a demand for Angora rugs in the United States which so far has not been supplied by domestic production. These rugs can be purchased at prices ranging from $4 to $8.

Another article of manufacture from the skins is the carriage robe, rivaling in beauty and durability the buffalo robe, which is no longer a factor in the market. They are not expensive when the demand for skins is considered, and may be purchased for about $20. The smaller skins of the does and wethers and the kid skins find an extensive use in baby carriages, and are exceedingly attractive in their brilliant white.

These skins are used largely in the manufacture of children's muffs and as trimmings for coats and capes. The finest kid fleeces adorn the collar and border of some of the ladies' most handsome opera cloaks. In the stores they are sold often under some peculiar name which does not inform the purchaser that they are ornamented with the hair of the Angora goat, and so thousands of such articles are worn by people who are unaware of the true name of their "furs."

There is a tariff of 12 cents a pound on mohair and a varying schedule applying to mohair goods, but skins having fleeces attached come in duty free. Importations are without doubt very large, but it is impossible to give the figures, as the Treasury Department does not keep the records of imports of Angora skins separate from skins of other goats. Our source of supply for these imports is Cape Colony.

THE ANGORA GOAT INDUSTRY OF ASIA MINOR.

By WILLARD C. BAILEY, M. D.,
San Jose, California.

In pursuance of a purpose to visit Asia Minor to study the Angora goat industry and to secure some of the goats for importation into the United States, the writer so arranged his itinerary as to permit a visit, during the winter of 1900–1901, to Bradford, England, the great mohair market of the world, as a step in the journey to the East. His observations at Bradford and experiences in Turkey are briefly recounted in the following pages:

THE MOHAIR INDUSTRY AT BRADFORD.

Since about the year 1836 Bradford has gradually increased her demand for mohair until now practically all of the Turkish and South African clips are marketed there. The mohair is purchased by dealers and commission men, and the manufacturers select those grades which their trade may demand. Thousands of people are employed in the preparation and manufacturing of the mohair, each mill, with its employees and their homes, constituting a suburban town. One of these, located about 10 miles from Bradford, working almost exclusively on mohair, employs over 3,500 persons.

SORTING.

After the mohair arrives at the mill it must be sorted. Each fleece is carefully picked over by hand and the different portions classified according to fineness, freeness from and length of kemp, length of mohair, soundness of staple, luster, foreign materials, etc. Usually the sorter makes six grades, the poorest containing the kempy parts of the fleece, the coarse mohair, etc., which are expected to spin about No. 24,[a] or a very heavy yarn. The best grade contains the finest fibers, which are comparatively free from kemp and foreign materials, and spins No. 40 yarn and upward.

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[a] To give breeders a clear understanding of what is meant by quality is a more difficult job than what it looks to be. By quality is generally meant the length or fineness to which a fiber will spin, for the finer or smaller the fiber is the longer and smaller it can be spun.

It is this fact that makes us speak in the wool trade of the raw article being of 60's or 40's quality, or any other count as the case may be. Any man can see that to spin out a wool of 60's quality will require a much finer article than he will if he spins out a 40's quality wool, but while it is possible to spin a wool on the length of 40's quality, it is absolutely impossible to spin a 40's wool on the length of 60's.

It is a scientific fact that you can spin down a wool to any count below its own natural length, but you can never spin up a wool beyond its natural limit. When we speak of 60's quality wool it simply means that there are 60 hanks, each hank measuring 560 yards, to weigh 1 pound; or, in other words, there are 33,600 yards of spun yarn of this quality to every 1 pound weight of material. Eighty's quality is a much finer quality wool still, and this means that it will spin to 80 hanks of 560

The sorting is done on tables having a netted wire top, through which the dust, sand, and foreign particles in the mohair fall. Under the screen a strong current of air, circulated by means of a powerful exhaust fan, carries away any detritus, giving the sorter a comparatively clean atmosphere to breathe. An expert working on fairly good mohair sorts about 200 to 300 pounds a day.

SCOURING AND WASHING.

The mohair must be thoroughly cleaned of any yolk, grease, dirt, or other material with which the fiber may be covered. The percentage of shrinkage in washing varies considerably, but from 13 to 20 per cent is the average. Turkish mohair is usually the cleanest that comes into the Bradford market. This is due to the fact that Turkish hair is sorted and some of it washed before it reaches the factory. The machines used for scouring are elaborate, consisting of iron tanks filled with prepared liquor, in which work automatic racks. The mohair is immersed in these tanks and is thoroughly cleansed before it emerges from the last one, after which it is dried.

CARDING.

The short-staple mohair (that less than 6 inches long) must now be run through the carding machines, as it is not long enough to comb. This machine consists of a number of cylinders of various dimensions, revolving in opposite directions and at different speeds. The cylinders are covered with sheets of leather or rubber, in which are inserted small steel-wire staples slightly bent in one direction. The object of the carding machine is to produce a continuous band, or "sliver." The fibers (mohair and kemp) composing this sliver are closely intermingled and lie crossed in every direction. The amount of kemp in carding or uncombed mohair greatly affects its value.

PREPARING.

All long-staple mohair is run through "preparers" previous to being combed, instead of being carded. The preparers straighten the mohair and cause the fibers to lie parallel.

COMBING.

Formerly combing was done entirely by hand, but now machinery does the work much more economically. The object of combing is two-

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yards each before it will weigh 1 pound, or really a production of 44,800 yards to every pound of weight. Such a statement, which is actual fact, lends itself to much imagination, for such yarns when spun are indeed small, one single pound of 60's reaching over 19 miles in length.—*S. B. Hollings, Bradford, England.*

fold—the long fibers, known as "tops," being arranged parallel to each other, and the short fibers and kemp, known as noil, being separated from the long fibers. Most mohair is subjected to two combings. The first, or "noble," comb is so arranged that all fibers shorter than 2½ inches (first noil) are collected by themselves and the longer fibers (first top) by themselves. The top of this noble comb is then run through a second machine, known as the "lister" comb. The lister is so arranged that all fibers in the first top shorter than 4½ inches (second noil) are separated from the longer fibers (second top), which are collected by themselves. This top, which is produced by the lister comb, is almost free from kemp and is ready for drawing and spinning. The value of the second noil is considerable, as there is much short mohair mixed with the kemp. This second noil is carded.

The most valuable mohair is the long fine staple which is comparatively free from kemp. It spins a fine yarn and shrinks least in combing.

Part of the spun yarn is manufactured in England, but much of it is exported to France and Germany.

The continental mills run on practically the same basis as the English factories, with the exception that the former start with spun yarn.

THE ANGORA GOAT INDUSTRY IN TURKEY.

Constantinople is the center for the Turkish clip, and, as the mohair from different districts in Asia Minor varies considerably, it was well to know where the various kinds were grown. Consequently Mr. Gavin Gatheral, who has been engaged in the mohair business in the Orient for over thirty years, was consulted and gave the writer much assistance in collecting information.

PASSPORTS.

On the morning of February 21, 1901, a passport (a very necessary document) for the interior was obtained. Without this no one is allowed to enter Asia Minor. The passport is written in Turkish characters, stating where one is going, what his business is, and giving the usual personal description and nationality. It required almost the entire day to get it. The dragoman considered this rapid work and assured me that it would have taken much longer if we had not distributed some small fees. The charge for the passport was about 50 piasters ($2.50).

THE START FOR ASIA MINOR.

The boat which leaves Galata Bridge, on the Golden Horn, for Hida Pasha, which is on the Asiatic side of the Bosphorus and whence the train starts for Angora, goes very early in the morning. The time card is printed in Turkish reckoning, which differs from European time about six hours. The boat landing was reached fully two hours before the boat started. At last the ticket office was opened and a ticket was procured to Eski Chehir, which is the end of the first day's run and where the train rests for the night on its way to Angora.

At Hida Pasha the guard demanded the passport. He noted in a book all of the detail on this document. The officials had neglected to state the writer's residence in Constantinople, and this allowed room for argument. However, the important item was finally inserted, the contents of a small hand grip were turned out upon a table and passed, and the train was boarded. After much delay a station gong rang. A few minutes' pause and it rang again, accompanying this ring with two short rings, indicating that it was the second warning; a five minutes' pause, a horn sounded; another brief pause; the whistle blew and the train started. This proved to be the regular system of warning at each station before the train started.

AGRICULTURAL FEATURES.

The railroad ran for a short distance along the shore of the Sea of Marmora. Away from the coast brush-covered hills arose. Between the hills and the track small haphazard vegetable gardens and orchards were interspersed. The almonds were in bloom and the pink peach buds were just opening. Olive trees seemed to grow wild, or at least they had been planted in very irregular fashion. Some of them might have grown there in Greek and Roman times, as they were fine old trees. No vineyard, orchard, or garden containing more than 2 acres of ground was seen. Men were plowing the reddish soil with wooden plows drawn by oxen. Sometimes six or eight men, working side by side, were spading a patch. They choose only the best bits and the easiest land to cultivate, and between the cultivated patches—none of them was fenced—many flocks of fat-tailed, varicolored sheep, common goats, and scrubby cattle were herded. Usually two or more men, a few dogs, and pack burros were with a herd of 100 or more. Black, brown, and white, with combinations upon the same animal, seemed to be the colors for the sheep and goats.

The ewes were commencing to drop their lambs, and those lambs a few days old were scampering about in the sunshine.

The train moved leisurely along and arrived at Ismid, at the head of the Sea of Marmora, at about noon. Leaving Ismid and the sea, the railroad runs through a valley. Part of the land has been under cultivation, but the larger part was covered with small brush. There were a few herds of large, black cattle, called buffalo here, and everywhere common goats, sheep, and small cattle were feeding.

THE MOUNTAIN COUNTRY.

The train gradually ascended the valley and was soon well up in the mountains. The railroad passes through a wild, rocky canyon, with perpendicular stone walls a thousand feet high, whereon huge bowlders hung suspended. With increased altitude the atmosphere had become colder, a fine sleet began falling, and distant snow-capped peaks appeared.

On a trail in these mountains a small caravan of camels, which was returning from the coast laden with provisions, was passed—the first seen. The caravan is one of the principal modes of transportation in Asia Minor. Formerly all the mohair was brought to Ismid by camel, but now the railroad transports most of it to Constantinople from some interior station. On leaving the railroad one sees many of these caravans plying between interior points.

ESKI CHEHIR.

At 6 o'clock in the evening it was dark, and the train arrived at Eski Chehir at 9. In order to get out of the station it was necessary to show the passport to the guard, tell why one came to the place, where he was going to stay in the town, and how long before he would kindly leave the country. All this was noted in a book before two Turkish witnesses.

Eski Chehir has about 16,000 inhabitants. It contains about 3,000 houses, about 200 being those of Greeks, about 300 of Armenians, a few of Jews, and about 2,500 of Turks. It is situated on a great plain, part of the houses resting on the south side of a low hill. A small stream, the Prusak River, flows through the old town, which is about a mile from the railroad station, the new town being grouped around the station. Not a bush large enough to be called a tree or anything save the low mud houses relieves the monotony of the plains.

A fine snow was falling in the morning, and the "hausfrau," an old German woman, said that heavy storms might be expected any time in February and March. Local news travels rapidly in Turkey, and before noon Mr. Mermarian, an Armenian representative of Mr. Gatheral, called. He had studied some English at the American school at Constantinople, and could speak, read, and write Armenian, French, and Turkish. He said that if the mohair came from more than a few miles from Eski Chehir he could tell the fact by the quality and appearance of the hair. This he thought due to particular kinds of food and range. As an example he mentioned Moussacuza, some hours distant in a southwesterly direction, where a few stunted pines and oaks replaced the ordinary sagebrush. The hair from this district is very fine. It has a luster and a yolk quite foreign to most of the Eski Chehir and Kjutiah mohair.

One of the first things a goat man notices upon entering the town is the Angora mutton hanging in the shops. There is no question about the identity of the animals, as most of them are not skinned. They are mostly old wethers and does. The Turk eats many goats of old age, and knows it. The young animals are too valuable to kill. However, a few kids are sacrificed for the spring trade. Besides goats, the Turk uses fat-tailed sheep for mutton. Young fat-tailed sheep is worth more than old goat, but kid is worth more than lamb. About twenty old wethers were driven past us, down the main street, to the butcher's. They were large animals, weighing about 110 pounds, with fine skins, and were valued at 85 piasters ($4.25) apiece.

The skin forms no small portion of the value of the animals. Nearly every shop in the grand bazar had a few goatskins, mohair, or some goat product. In a nearby warehouse were many freshly cured skins ready for the German market. The largest and finest were worth 38 piasters ($1.90), and the smaller ones about 28 piasters ($1.40). The mohair had been shorn from some of the smaller skins.

Near the center of the town is a fine hot spring. The Turkish tanners have made use of the water for years past and have polluted the place with an odor which is trying to a foreigner. The place about the spring presents a busy scene—washing, tanning, drying, and other work which hot water facilitates, being in progress.

ANGORAS ABOUT ESKI CHEHIR.

There are some good flocks of Angoras around Eski Chehir, the mohair from this district being recognized at Constantinople as the best. The fleeces are fine, not very oily, and the fiber has that indefinable flexibility and tenacity which renders it comparatively easy to spin.

A visit was made to the flock of Moustafa Bey, which was feeding on his farm between Sikeurea and Moutalib. The route to the Bey's farm lay to the southeast of Eski Chehir, over broad level plains. Part of the land was under cultivation, but most of it was covered with a fine-fibered sagebrush, with no trees. Moustafa Bey belongs to the effendi (upper class—those who can read and write or those who are very wealthy). He did not live on the ranch. He was considered a progressive character, as he had one American plow—a very rare thing in that country—and had also imported his Angora bucks from Bei Bazar, some four days distant.

The foreman of this farm said that the best bucks—those which Moustafa had some years before imported from Bei Bazar—sheared 4 or 5 okes (8 or 10 pounds) of "tiftick" (mohair) a year and the best does about 2 or 3 okes (4 or 6 pounds). He said that they had selected the heaviest shearers each year, and that they had disposed of some of the poorer ones to their neighbors. The flock average about 3½ pounds per year. Men came from Kjutiah, a day distant, to get bucks from this flock. Many goats around the country had previously been examined, but they were not what it was hoped to find, and much has been expected from this flock. As stated, Moustafa Bey was quite an enlightened Turk. He was breeding that flock for the money to be made out of it, but his breeding was rather haphazard. However, the flock was the best lot seen around Eski Chehir.

There were about 300 fat-tailed sheep and as many goats in the flock, which was in charge of some shepherds and their dogs. The Turk uses dogs, not as an aid in herding, but as a means of protection for the flock. There are many stock thieves and the dogs are trained to be watchful. They are large, powerful animals of a dirty gray color, and each dog wears a collar of sharpened spikes, so that if he attacks anything his own neck is protected. One always calls to the herder when visiting a flock and he secures the dogs, which have been known to attack men on horseback, and always prove a powerful foe.

Most of the Asia Minor flocks of Angoras have some black or bluish black animals in the herd, and Moustafa's flock was no exception. Two yearling bucks were caught for examination. They were kempy, bare-bellied, and generally inferior animals. The flock was then carefully looked over. Some of the old bucks of Bei Bazar origin were fairly well covered with fine hair, considering their ages. They were poorly covered on the bellies, were barefaced, and some were oily, but they were good bucks. There were some good 3-year-old and 4-year-old does with heavy, fine fleeces, and fairly well-covered bellies. Finally a young doe was caught which was the best animal noticed in the flock and a good sample of the best in Asia Minor. She had a fair foretop of curly mohair reaching down on the nose; small horns two-thirds of an inch wide and one-half inch thick at the base, gradually tapering toward the apex, rough and corrugated, translucent without dark discolorations, with a tendency to twist, and curving gracefully backward at an angle with the neck of possibly 60 degrees. Her ears were about 6 inches long and 2 inches wide, and drooping. The inside of the ears was comparatively free from hair, while the outside was covered with short stiff white hairs, except at the base, where a curly mohair overhung them. The eyes were the peculiar yellowish tinge which is common to most Angoras (there are some white-eyed, short, erect-eared goats in sections of Asia Minor), large and round, with elongated pupils. The eyelids were slightly discolored with a few small, round, dark pigmentations. The nose was long and slender, with a few pigmented spots on the nostrils. On the lower lip, close to the mouth, a few coarse white hairs grew. She had the usual milk teeth and the two permanent teeth of a yearling in the lower jaw. The whole head was well proportioned and gracefully poised on a slender, rather short, heavily mohaired neck. The mohair on the neck was of the same character as that on the body and about the same length as that on the sides, and it hung in ringlets. Her body, including the belly, was unusually thickly covered with silvery white, glistening ringlets of mohair about 12 inches long. It was of very fine fiber, would spin No. 40 yarn and up, and was soft and pliable. The sides, hips, and region around the tail were comparatively free from kemp. However, on closer examination of the slightly yolky base of the curls, a few fine, white, lusterless hairs (kemp) from 1½ to 2 inches long could be seen. On the belly fine short kemp was rather plentiful, from 2 to 5 fibers being in a lock of mohair. Her slender legs were well separated, covered to the knees with long mohair and to the ankle with fine, curly mohair. They were almost hidden from view by long mohair, which hung almost to the ground at this time of the year. Her tail was erect, covered at the base with fine, curly mohair, and feathered with a 3 to 4 inch fleece of coarse white hair. She appeared to be about 3¼ feet long, measuring, while standing in an erect position, from the center of the forehead to the root of the tail, 1¼ feet broad, and about 2 feet high at the shoulders. She was of average size for her age and would have weighed between 50 and 60 pounds. She lacked proper appreciation at home, so she is now in America.

February 24, 1901, was an unusually windy, sleety, cold day in Eski Chehir, but between showers a start was made for Moussacuza, the Circassian country, which is noted for its fine mohair. The Circassians, unlike the Turks, are quite energetic.

Many herds of Angoras were passed, feeding along the road. Some of the goats were examined and inquiry made as to who had the best, so that when the village was reached it was known who owned good goats. After some questioning the best flocks were located and one of the men of the village agreed to act as guide. Some distance was covered by driving, followed by a walk over hills thinly covered with scrub oak, scrub pine, and a kind of bunch grass. A flock of some 500 animals was found, but a search of the herd for suitable goats for exportation failed to reveal any. The mohair was bright and fine, but kempy and thinly set upon the animals. One other flock of about the same character was visited, and the party returned to town.

At the coffeehouse an elderly man of important demeanor said he had some good Angoras, but that he had no mind to sell any. He finally agreed to show what he had, however. An examination of his flock showed that it did not include such animals as were wanted, and, as it was getting late and it was dangerous to be out in that country after dark, a return was about to be made without any goats when they brought a late buck kid which had been kept as a pet in a harem. He approached the ideal, although nothing was known of his parentage. After some parleying the goat was taken, and the party arrived at Eski Chehir shortly before dark. Eski Chehir being at the junction of the railroads for Koujiah and Angora, men came from both these towns and readily talked of the cattle, sheep, goats, climatic conditions, vegetation, etc., of their districts.

THE INTERIOR OF ASIA MINOR.

On Saturday, March 2, 1901, an extended trip into the interior of Asia Minor was begun. The plan was to encircle the town of Angora, working always to the best goat districts in the vilayets of Brusa, Angora, and Kastamuni.

In driving in a southeasterly direction toward the town of Bei Bazar many flocks were seen along the road. About dusk the town of Bozan was reached. Around the town lay the scattered gravestones of countless generations. Most of the Turkish villages are surrounded by graveyards which cover, in an untidy and irregular fashion, acres of ground. All Asia Minor seems to have been a vast graveyard. One finds acres and acres of tumbled-down gravestones miles from any present habitation, and the writer's party drove for some distance over these gravestones before they came to the mud huts and ruins which the present generation occupies.

Next morning after breakfast and the usual delay a start was made, most of the people of the town being at hand to witness the departure. Thin ice had formed during the night but it was warmer than it had been. Just outside the town a large flock of Angoras, which had camped in a part of the graveyard, were just starting for the day's feeding grounds. There was not a tree in sight, but the low hills were now covered with bunch grass instead of sagebrush.

A house and a goat shed were seen on a hillside close to town. The hill had been partially cut away and a roof of brush built at the same angle as the hillside, the front being open, with the exception of a small part which had been fixed for the human occupants. It looked like a large western "dugout" which had been opened on one side. Several such sheds were seen throughout the country.

The road wound in and out over hills and through open canyons. The surface soil, which was of a reddish color and about 4 feet deep, rested on lime rocks. Evliya Effendi, in a narration of a trip to Angora about 1550, translated by von Hammer, says that the country was noted for its Angora goats and fine lime. Food was scarce, and most of the goats seen were thin, the mohair having a peculiar reddish tinge, probably due to the soil. In one small valley, possibly 3 miles long and a mile wide, there were at least ten flocks of Angoras feeding. One felt as if he were trespassing upon private grounds here. Many of the people had never seen a man in European dress. Some Turkish women in bloomers were herding the goats and others were washing in a small stream which ran through the valley, and they turned their faces away or hid behind stones or bushes while the strangers passed. The roads were very muddy and sticky now and progress was slow.

A stop was made for the night in a miserable village, and a room secured on the ground floor which was full of vermin and opened into a goat shed and blacksmith shop.

The next day the road gradually ascended into high mountains. A few scrub oaks and pines covered the hills, and a bush which looked like laurel grew plentifully. Reaching the summit the country toward Bei Bazar stretched in broken plains, with broad, high valleys. Here and there small villages—collections of mud huts—could be seen. As the way descended one or two of these towns were passed. Rarely was an isolated farmhouse seen, the people preferring to live in villages for protection from robbers and for sociability. Here and there a goat camp at the mouth of a cave or an occasional flock of Angoras were the only evidence of life.

ANGORA.

The hills became more rolling and were covered with a fine-fibered sagebrush, similar to that which covered the plains of Eski Chehir, and ere long the village of Angora, on the Bei Bazar plains, was reached. This district is reputed to have the best Angora goats in Asia Minor. All the Turks speak of Bei Bazar breeding stock.

Paul Lucas, who made a journey over the country by order of the French King in 1705, describes the district as a beautiful plain, but so hot that he had to change his route to get protection for his horses and men. H. C. Barkley, who traveled the country in September, describes it as a "rolling sea of land, treeless and almost waterless, hideous in its vastness, desolate, burnt up, brown, and barren. Hour after hour, day after day, we kept looking for something green—a tree, a garden, a real mountain, something to break the dull monotony—but it never came, and so we struggled on, getting more and more weary as each mile receded."

The goats were in the most sheltered valleys and not on the high mountains. The country was alive with Angoras. A fine flock of 400 were feeding close to the road and a halt was made to examine them. The fleeces of these goats were not oily. The fiber was of fine quality, rather thickly set on the body, and the animals were fairly well covered. The average yearly clip was estimated at 1 oke (2¼ pounds) per head. The herder caught a 5-year-old buck, which had come from Sarai, a nearby town. He had a very heavy, long, fine fleece, rather kempy on the hips and thighs, but good on the back. His ears were covered with pigmented spots. There were some black and brown goats in this flock. The does were very thin and a cold storm had caused many of them to drop their kids prematurely. One farmer said that two-thirds of his flock had aborted. Some of the grown goats had died. Mr. Tchihchiff, a Russian who visited Asia Minor in 1848, and who made some study of the plant and animal life of the country, says (Vol. II, Chap. IV): "In cold winter, owing to the lack of proper sheds, large numbers of the Angoras die, and then a common buck is bred to the remainder to propagate the race."

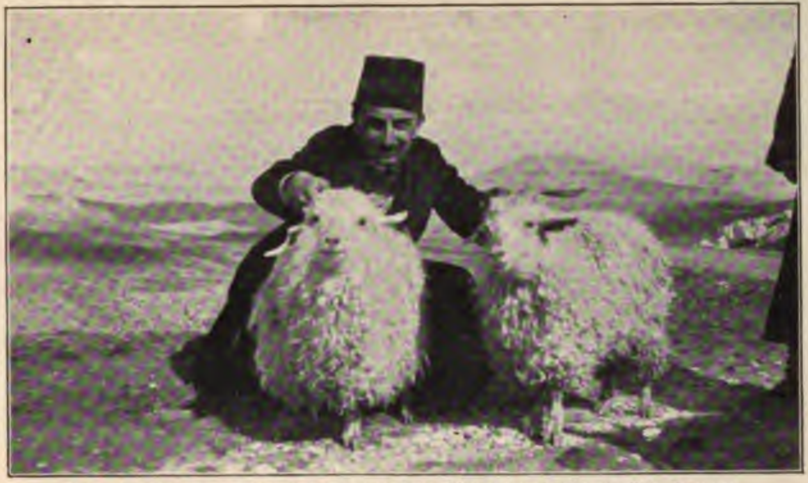


FIG. 1.—ANGORAS IMPORTED FROM ASIA MINOR IN 1901 BY DR. BAILEY.

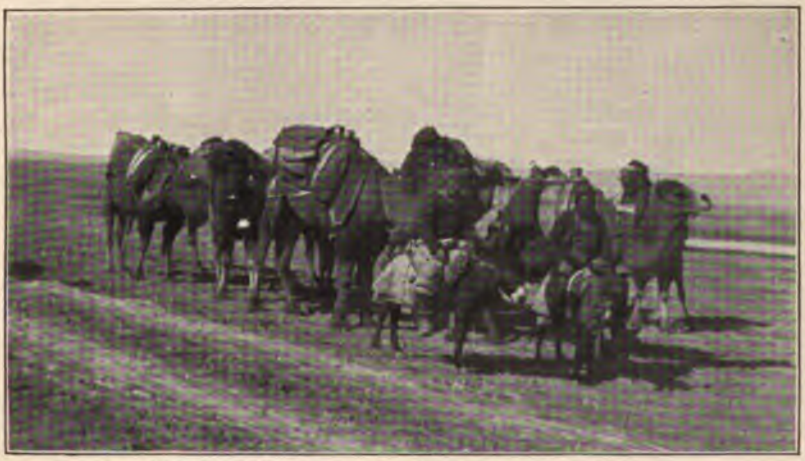


FIG. 2.—A CAVARAN IN THE INTERIOR OF ASIA MINOR.

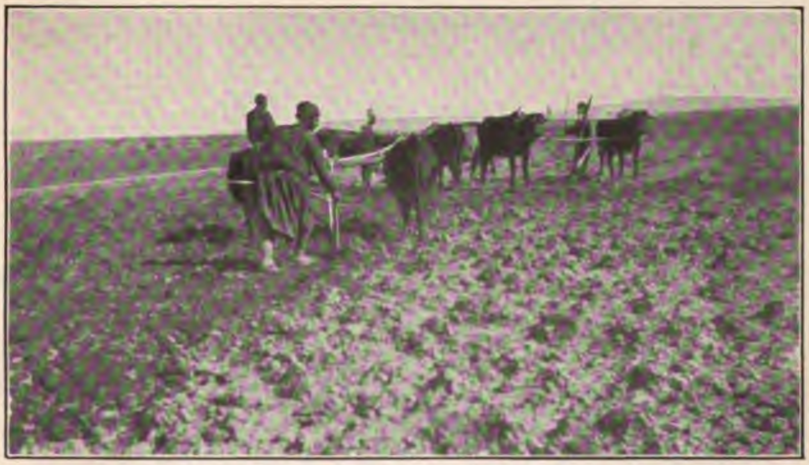


FIG. 3.—PLOWING IN ASIA MINOR.

FIG. 1.—ROLLING PLAINS NEAR BEI BAZAR.

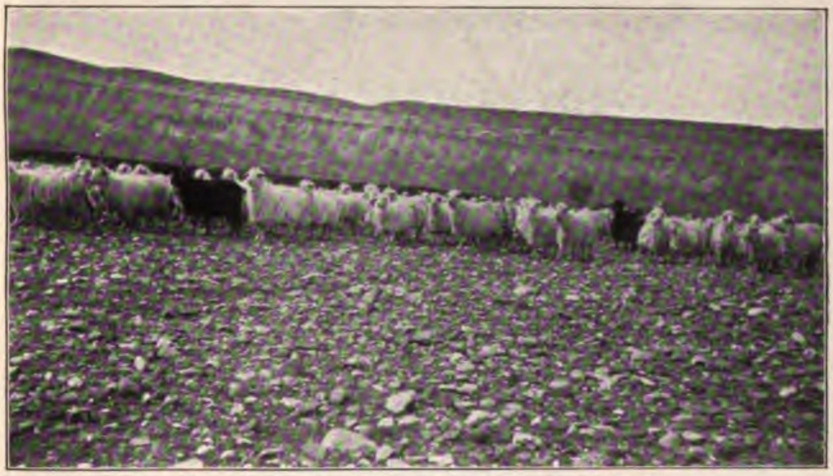


FIG. 2.—BEI BAZAR ANGORAS, SHOWING COLORED ANIMALS.

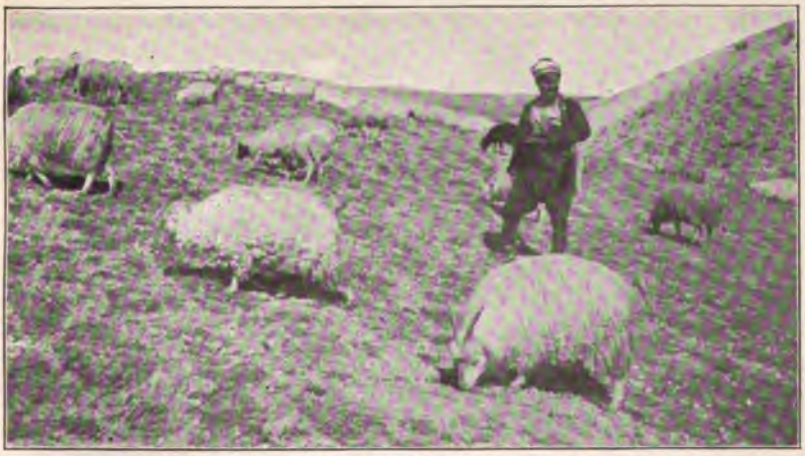


FIG. 3.—ANGORAS FEEDING ON SAGEBRUSH.

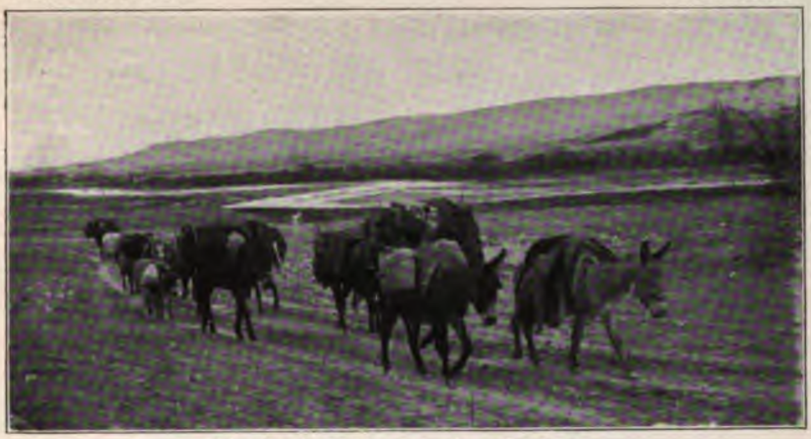


FIG. 1.—PACK TRAIN ON SAKARIA RIVER.

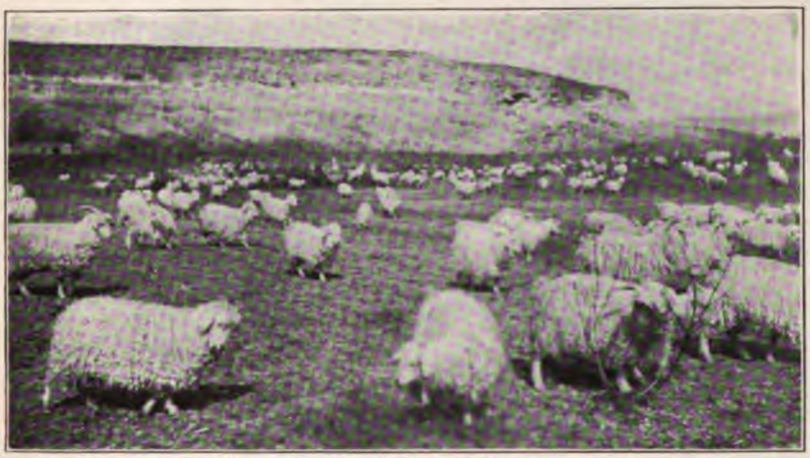


FIG. 2.—ANGORAS FEEDING NEAR SAKARIA RIVER.

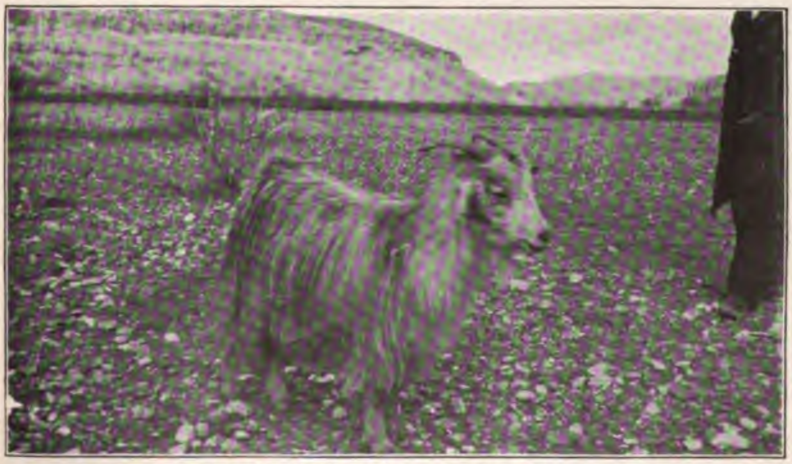


FIG. 3.—COMMON GOAT OF ASIA MINOR.

Owing to the cold, snowy springs in Asia Minor, the goats do not drop their kids until April or May. Occasionally cold storms at this time of the year kill a large number of the kids. The Turk has learned that the kidding season is a most important time. If he would raise a large percentage of increase he must be very careful with the delicate new-born kids. If he has a large flock he separates the bucks and wethers from the does and the latter are herded as close to the home place as the food conditions will permit. When a kid is dropped the mother is allowed to stay unmolested with it until evening and then she is driven to the village or farm. If there be jackals or other wild animals on the range, the kid is immediately taken to some protected place, and the mother is carefully driven with it. The mother and kids are not separated, and within a few days the kids are accompanying the flocks on the range. The Angora goats rarely have twins, but the Turk notes that the common goats often do. If the season be a favorable one, the kids grow rapidly and in a few weeks are very active. Often one sees a large yearling with a kid by her side, but the Turk knows that this weakens the mother, and if he has two flocks he puts the doe kids with the wethers at breeding time.

The kids are not castrated until after they have developed buck horns. Sometimes the testicles are removed, but often the cord is twisted and the testicles atrophied. In the early days of the Angora industry in America one of the importers received several goats which had been rendered sterile in this way. It is possible that the Turkish buyer did not know the difference between these wethers and bucks. The kids are shorn as yearlings, and the fleece is classed with the rest of the mohair.

The flocks are often watched by hired herders and the owners. The goats eat the tender tops of the sagebrush and keep well together, while the herders and dogs follow at some distance or walk before the flock to keep the leaders from going too fast. The herders, with dark sun-browned faces, partially protected from the elements by a self-tied turban, homespun shirts, jackets, and pants, wide leather belts, with knives and pistols, and rude sandals, make a picturesque appearance.

The herder rarely has meat to eat, rice and corn or rice flour made into different dishes being his principal diet.

For some days an examination was made of goats around the Bei Bazar country, and the journey continued along the Sakaria River until it was found that the fleeces began to get oily.

Here the river had worn its way through strata of rock and the cliffs were covered with Angoras. Leaving the river the way was into the mountains toward Kastamuni. There was much scrub pine on the hills in this country, and the farther one went the more oily the goats became, the natives agreeing that it was the pine which caused the oil.

One buck, which the owner thought was very fine, was so oily that the fleece was black and soggy. Oily goats were not wanted, so the course was changed toward the town of Angora. The goats now became less oily, but they were not so well covered and the mohair was no finer than had been seen around Bei Bazar; hence a return to that place was decided upon.

GOATS AT BEI BAZAR.

A Turk, Hiline Effendi, who was met in Bei Bazar on a previous visit, insisted on a visit to his farms. He was the wealthiest man in the country and owned about 2,000 goats. On the way to the farm, which covered broad bottom lands along the river, some fine flocks of Angoras were visited. This man was very clever, and politely said that it would be impossible to take any goats out of the district.

After some time spent at the ranch house a visit was made to a house where some hammers lifted by water were thrashing rice, and Hiline asked much about American machinery. He had noted the lack of improved farm machinery in Asia Minor, but he objected to American inventions on the ground that they were too large and expensive.

Before leaving the ranch two fine goats were secured, which were carried in the carriage. Much of the day had been spent and but little distance was traveled before dark. That night a private room behind a butcher shop was secured.

The next day the roads were very muddy; the horses mired and everybody had to walk. After a few days of slow traveling the railroad and a train of cars came in sight. Eski Chehir, which was bad enough on first arrival, now seemed to be the center of civilization, but the party was doomed to disappointment that night. The horses moved slowly, and at sunset were still two hours away from Eski Chehir. The driver insisted on feeding himself and horses at a small town where we were before proceeding. It was a moonlight night, so reluctant consent was given to wait a half hour. Two hours passed before the driver would think of starting. As two hours would have given a party of robbers time to anticipate any movement, the night was spent here, and Eski Chehir reached the next day.

SHEARING THE GOATS.

The question as to whether the Angora goat sheds its fleece has caused some discussion in America. All of the goat men here declared that they had never seen a herd of goats which would not shed if they were not shorn. They usually shear in the spring, about a month after kidding season, and once a year. The animal's feet are tied and, after the Turk has smoked a cigarette, he proceeds to clip the goat with hand shears. One man shears about 25 per day. The fleeces are not tied, but they are usually carefully skirted, any taglocks being sorted out, and each fleece rolled by itself into what is called by the merchants a "bump." The mohair is then packed in sacks ready for transportation.

THE ORIGINAL ANGORA GOAT.

Some writers have claimed that the original Angora goat—that is, the animal bred before the European demand for mohair caused the Turks to increase the flocks by crossing onto common goats—was a small, puny animal. The Turks said that so long as they could remember the Angora goats had been the same size as to-day. One man remembered that his grandfather had told a story about buying some Angora goats when he was a boy. The seller had estimated that the animals would weigh about 45 okes (100 pounds), and the grandfather knew that they would average at least 55 okes (123 pounds). The grandfather considered that he had made a clever deal and often told the story. There were many that were sure that the Angora had had its present size for over one hundred years, and they knew of various incidents which tended to prove this point. In none of the old writings could any reference be found to support the tradition that Angora goats had been smaller than the common goats or sheep.

THE BROWN GOAT OF KONIEH.

While in Constantinople Mr. Gatheral and other merchants exhibited some mohair fleeces which they said came from Konieh, in Asia Minor. The mohair resembled the white fleece, but upon careful examination it seemed to be composed of three kinds of hair—a coarse kemp, long curling ringlets, and soft downy undergrowth. Upon more careful examination the downy undergrowth seemed to have grown longer on some parts of the body, and as it increased in length it commenced to curl. The distal end of the curl was always a little lighter in color than the body end, possibly because of its exposure to the sun. There seems to be little record of such goats in old literature. Tournefort (Vol. II) says: "One is right to choose the fleeces of the Angora goat to those of Konieh, which is the ancient town of Iconium, where Cicero assembled the Roman army, because the goats of Konieh are either brown or black."

While waiting in Eski Chehir, special inquiry was made as to these goats. No one knew the origin of the animals. There were no church records which spoke of them. Old men said they had always been there. The number is decreasing year by year because of the demand for white goats and the crossing of Angora bucks, but there are probably 150,000 or 200,000 in the neighborhood of Konieh. The Angoras were brought to Konieh about sixty years ago, and the first cross resulted in a mixed brown-and-white fleece, but in four or five crosses the fleece became white.

The brown goats average about 2½ okes of mohair. It is known in Bradford, England, as "tchengnelly" (Turkish word meaning yellow), and usually sells for a little less than white mohair. The mutton of the Konieh goat is considered better than that of the Angora.

Some years 30 to 40 per cent of the does give birth to twins. They seem to be as thoroughly localized about Konieh as the white goats are about Angora.

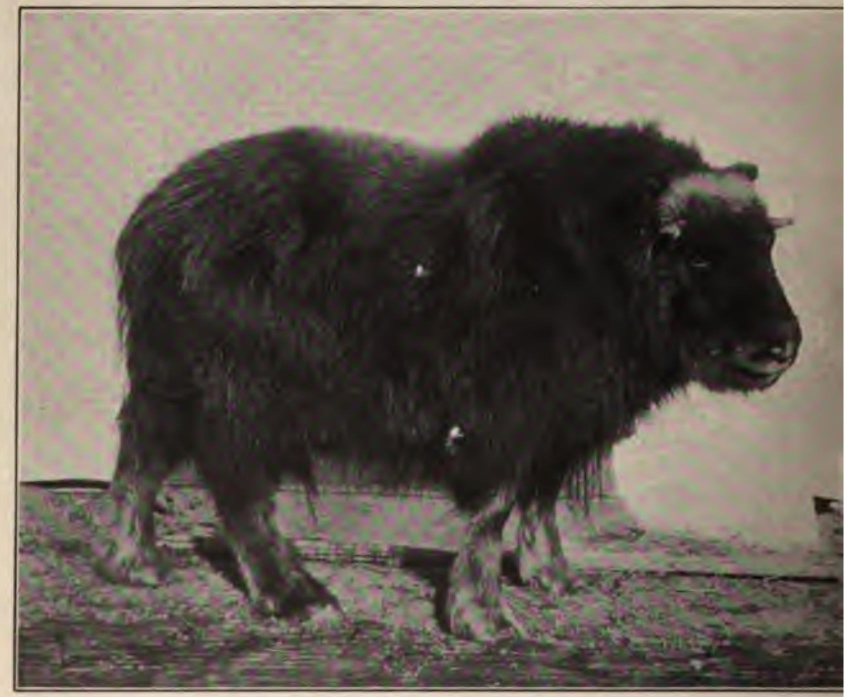
THE COMMON GOAT OF ASIA MINOR.

There are a great number of common and varicolored goats scattered over Asia Minor. They are herded like the other stock and killed for the skins and meat. In general appearance they resemble the common goat of other countries, but many of them are provided with two distinct coats of hair. The outer and longer coat is composed of coarse, lusterless white hair, from 4 to 6 inches long, underneath which a fine, downy undergrowth, 2 to 3 inches long, completely covers the animal.

After seeing these common goats with the downy undercoat, the Konieh goat with the downy undercoat, which had grown long and curled (mohair) in some parts of the body, and the Angora goat, which invariably retains some coarse, lusterless white hair (kemp) interspersed with the mohair, the query arises, Is not the mohair of to-day the gradual development, possibly due to some climatic or food conditions, of the downy coat of the common goat? If this be true, the Konieh goat may be the intermediate stage in this development. If this theory be correct, it has a practical application. If the kemp on the Angora of to-day is the remains of the original principal coat, and if the mohair is only the development of the downy undergrowth, then by careful breeding we may still further decrease the kemp, and in the future may hope for a kempless Angora.

SUCCESS OF THE ENTERPRISE.

On returning to Constantinople arrangements for the receipt and shipment of the four goats which had been purchased was secured, and after indescribable difficulties the Angoras were transported to Palermo, Sicily, and there transferred to an American lemon freighter for New York. They landed safely, somewhat emaciated after their long trip and peculiar handling, but they are doing well on American soil.



THE ONLY MUSK OX IN THE UNITED STATES.

Photograph furnished by J. H. Webster

THE MUSK OX.

By George Fayette Thompson,
Editorial Clerk, Bureau of Animal Industry.

FIRST MUSK OX IN THIS COUNTRY.

The only musk ox (*Ovibos moschatus*) in the United States arrived at San Francisco in November, 1901. It was captured in March of that year at Langton Bay, in the Arctic region of Alaska, by Indian hunters under the direction of Capt. H. H. Bodfish, of the steam whaler *Beluga*. These Indians captured four musk oxen—two bulls and two cows; but the bulls were killed before they reached the whaler, and one of the cows was killed by dogs on Baillie Island. The animal which was saved from the dogs was consigned to Mr. C. F. Periolat, of Chicago, who sold it to Hon. W. C. Whitney, ex-Secretary of the Navy, and it is now in the zoological park of New York City. The price paid for it is said to be $1,600.

At Topeka, Kans., on its way from San Francisco, it was inspected by Hon. C. J. Jones, better known as "Buffalo" Jones, who has hunted musk oxen in their northern home and is familiar with their habits. He pronounced it an excellent specimen, and it received at Topeka the name of Olive Jones, in honor of the daughter of Buffalo Jones.

The Bureau of Animal Industry is indebted to Mr. J. H. Webster, a tagger on its force at San Francisco, for the excellent photograph, a reproduction of which accompanies this article.

WHY CALLED MUSK OX.

The books state that this animal is called the musk ox because of a characteristic odor of musk, but Mr. Jones, already referred to above, says he detected no odor of musk about them. On the contrary, General Greely, who commanded the Lady Franklin Bay Expedition, and whose command killed many of them during their long stay in the Arctic regions, speaks definitely of an odor. He says: "The musky odor, I believe, will not be communicated to the meat if the animal is entirely dressed as soon as killed. A bull emitting a very marked odor when killed was dressed immediately, and showed no taint when eaten months afterwards." It is probable that the odor of musk is detected in bulls only, and in them at rutting time only.

DESCRIPTION.

The musk ox varies in length from 5½ to 8 feet from the end of the nose to the root of the tail, but, owing to its huge mass of woolly hair, it appears much larger than it really is. It is seldom over 3½ feet high at the shoulders. General Greely mentions one which weighed 1,200 pounds, but it is said that the bulls usually vary from 350 to 500 pounds. The cows weigh about 75 pounds less.

Mr. C. J. Jones[a] says the musk oxen were much larger than he expected to see. They look diminutive while standing, but this is owing to their very short legs. The bones are massive, indicating wonderful strength. "The bone between the ankle and knee, from joint to joint," says Mr. Jones, "is exactly the length of the width of my three fingers; their other bones were not in proportion."

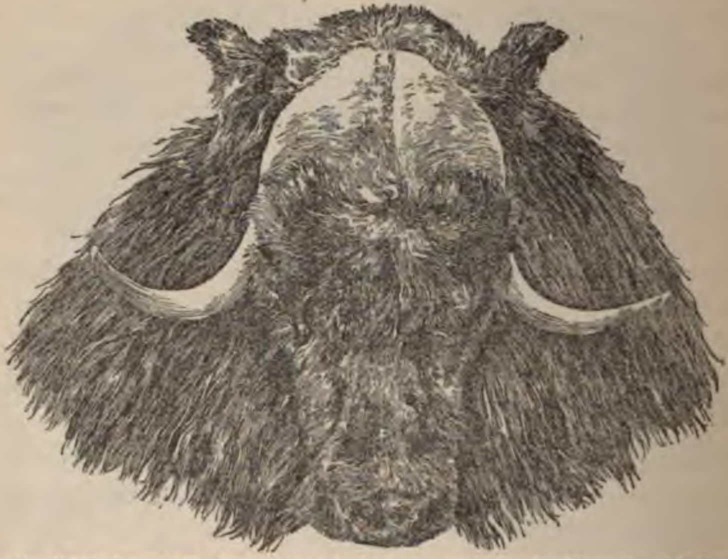


FIG. 211.—Head of musk ox, showing how the horns cover the head. (From Greely's Report.)

He also says that they possess great vitality and endurance. Their breasts are as broad and well developed as that of a Norman horse. The meat on the ham extends well down to their hocks and lies in rolls. When fat, a square cut across the buttock resembles variegated marble.

The horns were not very long on the animal recently imported, as it was only about 18 months old. In the grown animals they grow downward and outward. In the cows they are set wide apart, but with the bulls they grow over the head (fig. 211) in such a manner as to form an immense helmet.

There is a wide difference in statements as regards color, some stating that they are black, others brown, and still others gray. These discrepancies are supposed to be due to several causes, such as age, season, etc. Those musk oxen seen by Mr. Jones when he was hunting them in Alaska had glossy black hair, but he states that the one which he recently saw at Topeka had a reddish-brown appearance, but not so reddish as is shown in the lithograph (Pl. CI). This lithograph shows the color as seen by Mr. H. H. Cross, who painted the picture and who has also hunted the animals in Alaska.

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[a] Forty Years of Adventure, p. 372.

The hair is said to be very fine, long, and silky, growing thick upon the face, shoulders, and sides. It often sweeps the ground. There are two coats, as with the American buffalo and the Angora and Cashmere goats. The outer coat is the heavier of the two and is shed annually during the warm season. Mr. Jones says "the underfur is very long and compact; as fine as silk, and when twisted into a small thread tightly, a man can scarcely break it. Doubtless it would produce the strongest fabric known if properly manufactured."

The flesh of the musk ox is said to be excellent. The Lady Franklin Bay Expedition ate many thousands of pounds of it, and General Greely says it contributed very much to the health of the party.

HABITAT.

The habitat of the musk ox, according to Mr. Jones, is confined to that part of North America east of the Mackenzie River and north of the sixtieth parallel, including the islands of the Arctic Ocean and most of Greenland. General Greely says that a portion of the barren lands of British America, the Parry Archipelago, and other lands to the northward of the continent are the only regions now occupied by this interesting species. He says, further, that no traces of the animal have been found in southern Greenland, though it abounds in the eastern and northern coasts. Another writer states that they were found on the west coast by the *Polaris* expedition. It is quite evident that an accurately described habitat can not be made for the musk ox until all that part of the continent is carefully explored.

The situations preferred by the musk ox are rocky barren lands and mountains where grass and other food may be found. Some writers state that this animal, like the caribou, feeds largely upon moss. Mr. Jones, for instance, says that upon dissecting one which he had killed he found in the stomach "a little dead grass and a great amount of moss." The observations of General Greely were that they would not feed on moss. His remarks on the feed of this animal may be found on page 511.

EFFORTS TO CAPTURE MUSK OXEN.

The desire to capture some specimens of musk oxen and bring them to the United States is of long standing, but all efforts in that direction have failed until the arrival of the one brought here by Captain

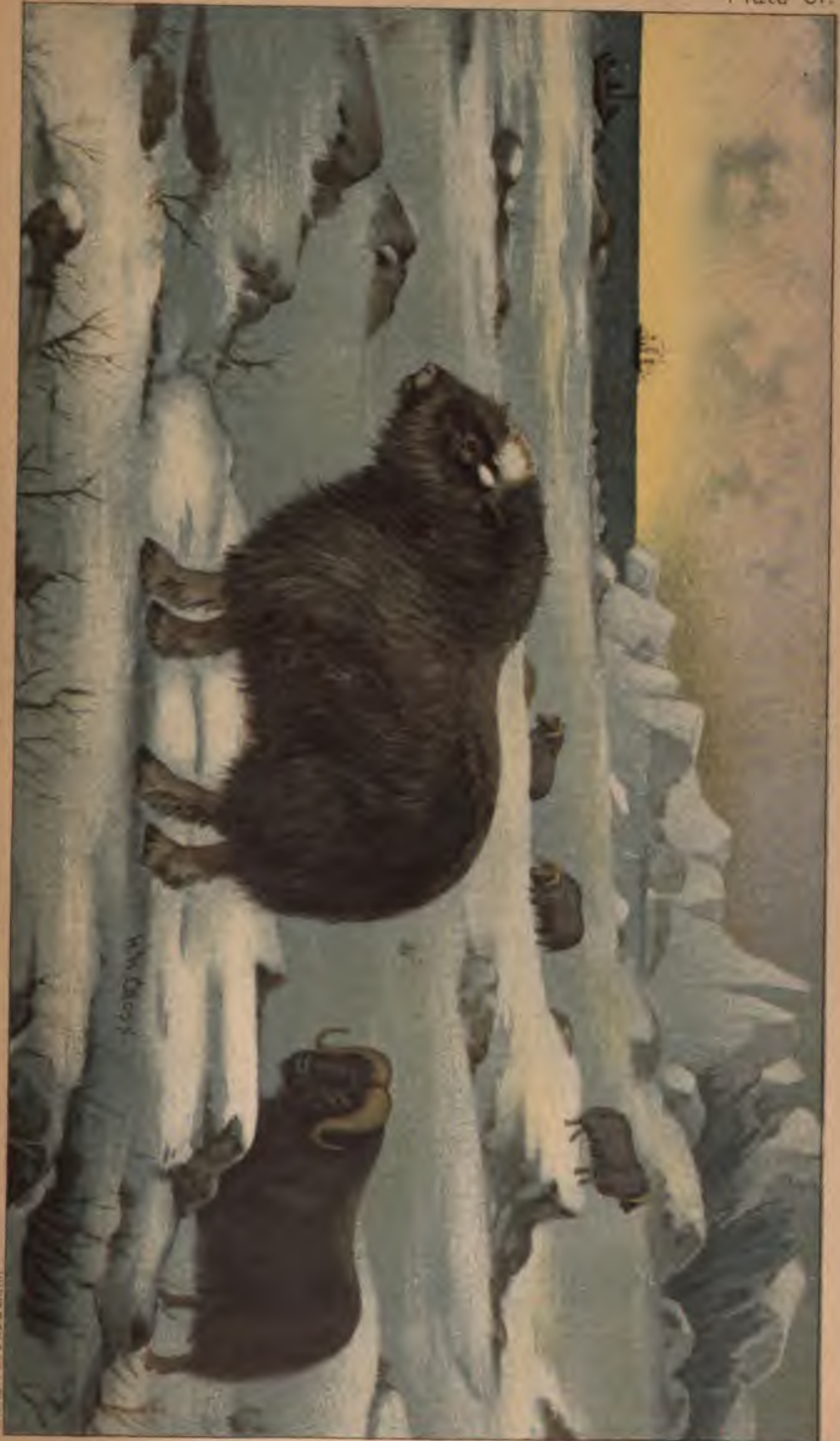
Bodfish in 1901. He started with 4 animals, as has already been stated, but 3 were killed by dogs soon after their capture. The habitat of the musk ox is so inaccessible as to add great difficulty to their capture and exportation. The greatest difficulty, however, is the opposition of the Indians. Mr. Jones was met on his journey to the land of the musk ox, by Indians, who warned him not to take any of the animals out alive. They explained to him a belief of their people that if any musk oxen were taken out alive all other animals would die or leave the country, and so the people would perish of hunger. They offered no objection to the killing of the animals, and they do this themselves as often as they are so inclined. Captain Bodfish succeeded only by assuring the Indians that he wanted the animals for their skins.

The guide employed by Mr. Jones refused absolutely to go farther when he learned that the object was to capture the animals alive. This, however, did not deter Mr. Jones and his companion, who finally succeeded in capturing alive 5 yearlings (2 bulls and 3 heifers) out of one herd. The journey out was begun at once, the men driving the animals, which were all tied to a single rope. After three days of travel of about 18 miles a day, the men awoke one morning to find that the Indians had cut the throats of every musk ox. They were determined that none of these animals should go out of the country alive, and it appeared to Mr. Jones and his companion that the Indians would win their contention, for they did not have the courage to return to the hardships incident to another capture, with the prospects of another loss in the same manner.

GENERAL GREELY'S ACCOUNT.

The following is General Greely's account of the musk ox as he saw it in the Arctic regions. The excerpt is from the Report of the Proceedings of the United States Expedition to Lady Franklin Bay (Vol. II, pp. 6 and 7):

> A portion of the Barren Lands of British America, the Parry Archipelago, and other lands to the northward of the continent, are the only regions now occupied by this interesting species. No traces of the animal have been found in southern Greenland, though it abounds in the eastern and northern coasts. The existence of the musk ox in Greenland and Grinnell Land with but little doubt resulted by migration from the American continent northward over the adjacent islands and their intervening frozen straits. Scarcely one of these islands has been visited where the remains of the musk ox have not been found. At one time Smith Sound had been crossed by these animals, as about twenty skulls have been found in Inglefield Land, north of the seventy-eighth parallel. That the species never reached Danish Greenland is confirmatory evidence that the island ice, part of which flows into Kane Sea as the Humboldt Glacier, likewise debouches by discharging glaciers into Melville Bay. To this extent I differ from Feilden, who inclines to the opinion that the musk ox reached Inglefield Land southward from Washington Land. Not only the opinion that there is little more difficulty in crossing Smith Sound in a favorable



MUSK OXEN. A SCENE IN NORTHERN ALASKA.

JULIUS BIEN & CO. LITH. N.Y.

spring than Robeson Channel causes this belief, but my experience regarding the remains in Grinnell Land. But few skulls were found by me in the interior, and, with one exception, they failed to show great age, thus indicating a comparatively modern migration. On the other hand, the remains of musk oxen near Humboldt Glacier and Foulke Fiord show signs of great age.

Although I found recent traces of musk oxen within less than 30 miles of the head of Greely Fiord, yet I agree with Feilden that they followed the east shore of Grinnell Land in their journey northward. Feilden reports abundant and recent traces of animals in Alexandra Harbor, Buchannan Strait, August, 1875. The dung of the musk ox was discovered by us at Cape Hawks, Rawlings and Carl Ritter Bays, and a specimen was killed by Sergeant Brainard, November, 1882, not far above the latter bay. Sergeant Brainard discovered fresh tracks at Thank God Harbor in March, 1882, and Lieutenant Lockwood likewise at Cape Britannia, 82° 44′ N., and at Cape Benét, 83° 03′ N., in May, 1882. This not only proves that the species was not exterminated in northern Greenland, but renders it very probable that the musk oxen of Koldeway originally reached the east coast through Nordenskiöld, Victoria, Nares, or possibly Sherard Osborn Fiord and the connecting valley. Siemens, one of *Polaris* crew, wrote:

"The musk oxen came (in 1872) in a northeasterly direction from east Greenland. All those that were killed were met in the same vicinity, on a plateau which trended from the north side of Newman Bay easterly between the mountains."

I have elsewhere referred to my belief that the northern limit of the inland ice is to the south of those fiords, and that the character of the country is like the interior of Grinnell Land. To the northward repeated inlets exist, increasing greatly the difficulty of the animals passing around Greenland. I am thoroughly satisfied of the natural disinclination of the musk ox to cross the ice, both from observation of our musk calves, who could not be driven upon it, and from the tracks of adults which followed carefully in places the longer, rough, rugged shores of Ruggles River rather than cross snow-covered ice by a shorter route. This migration through the east coast must have been a modern one, certainly within the present century.

This opinion militates against the necessity of further advancing the idea that "Greenland must end not far north of latitude 80° or 83°."

As to Grinnell Land, observations show that instead of the range of the musk ox being confined to the coast line and debouching valleys, he is found feeding and wandering in the whole fertile belt between Archer and Greely fiords, and from Chandler Fiord to the head of Very Valley.

Feilden has described the ovine character of this species. In addition I might say that when in numbers they generally form a circle, with young cows and calves in the center, and that much bellowing and threatening attitudes followed, but they were never found dangerous.

The musk ox was found in small herds from 4 to 20 in number. Occasionally one or two animals only were found together, but with rare exceptions these stray animals proved to be bulls which probably had been driven from large herds.

The senses of smell, sight, and hearing, which are said to be very acute, could not be accurately judged by us. It was uncommon that a herd was not readily approached, but such fact would not necessarily indicate lack of perception, but might easily result from indifference or a sense of perfect security in their great bulk and strength. On one occasion after killing several, the hunters had some trouble in keeping the rest of the herd away from the camp.

My own discoveries settled a number of questions that puzzled Feilden, and we know that not far from 200 musk oxen are now habitants of Grinnell Land, fed by abundant vegetation. Willow, saxifrage, dryas, and grasses form winter as well as summer food. I found large beds of willow that had been fed on during April, the musk oxen having broken the crust and scraped off snow to reach it. This was doubtless a favorite pasture ground, as plenty of saxifrage and scanty grass was in the same section. I observed musk oxen scraping the snow from grass, saxifrage, and dryas in early autumn, using hoofs for the purpose. The animal, as all Arctic mammals must, quenches its thirst by snow. It was surprising that the open river discovered by me in April, 1882, showed no trace of visiting cattle, although we saw many within a few miles of it. I suppose that not less than 50 herds of solitary animals were observed feeding, and none was ever seen eating lichens. The most fertile lichen grounds showed no signs of the animal. Feilden found only willows and grasses in stomachs examined by him.

It appears more than probable that the animal ekes out its scanty winter food (which in darkness must be gathered under extraordinary disadvantages) by its fat. The rapidity with which Arctic animals (among which the musk ox is not an exception) acquire fat is well illustrated by the experience of the Swedes in Spitzbergen during 1861. Nordenskiöld says: "The Swedes could hardly believe (them) to be the same species of animals (reindeer) as those they had shot at Treurenberg Bay scarcely four weeks before. Then they were so lean as if they had consisted entirely of skin, bone, and sinew; these, on the contrary, might have competed as fat stock at an English cattle show, for the largest reindeer had a layer of fat 4 or 5 inches thick on the loin."

Ten specimens killed the autumn of 1882 averaged 360 pounds of dressed meat, while 2 killèd the following spring weighed 260 pounds each, less by far than any other 10. The largest, which was about 1,200 gross, dressed 432 pounds.

The musky odor, I believe, will not be communicated to the meat if the animal is entirely dressed as soon as killed. A bull emitting a very marked odor when killed was dressed immediately and showed no taint when eaten months afterwards.

AMERICAN BREEDS OF FOWLS.

By T. F. McGrew.

[The Plymouth Rock.—The Plymouth Rock breed is the most popular creation of the American fancier's art. It is not only a beautiful bird, but as a general-purpose fowl it is unsurpassed. It is medium in size, excellent for the table, a good sitter, and at the same time rivals the smaller breeds in activity, hardiness, and egg-laying propensities. It is a favorite breed for the production of broilers and capons, and in the show room it excites the admiration and enthusiasm of all who love to see beauty and symmetry in our domesticated birds.

Nearly everyone is more or less familiar with the general appearance of the Barred Plymouth Rock, but there are comparatively few who understand the different points of these birds, the defects which the farmer tries to avoid, and the ideals of perfection toward which he is striving. The plumage of birds has an even greater effect in the characterization of breeds than have the coats of other farm animals, and hence the breeder pays special attention to the body color and the markings of the feathers on different parts of the body. Those who are strictly utilitarian in their aims may think that too much attention is paid to the feathering; but it should be remembered that the perfection of feathering and the ability to transmit this standard is an evidence of pure breeding and prepotency. Nor should the æsthetic element in the breeding of farm animals be entirely discarded. Beauty of form and beauty of coloring, bred according to a standard of perfection and developed almost to the exact ideals of that standard, serve to excite interest and enthusiasm beyond what can be realized by utilitarian qualities alone.

Considerable attention is properly given by the author of the bulletin to the plumage, the standard requirements, and the methods of breeding by which these are best secured. These are the points upon which information is perhaps most needed. The Buff and the White Rocks receive their due share of attention. Mr. T. F. McGrew, who has prepared the bulletin, is a well-known judge of poultry and a prolific writer on questions relating to breeds and breeding. The illustrations were made by Mr. George E. Howard, and have received the approval of some of the most skillful breeders of these birds.

The time has come when Americans no longer need to go abroad to obtain either beauty or productiveness in fowls. The best breeds that exist have been produced in our own land, and when their merits are fully understood there will be an increasing demand for them in other parts of the world.

The Wyandotte—The Wyandotte, like the Plymouth Rock, is a general-purpose breed and has the same qualities to recommend it. The differences between these two breeds, except in feathers, are not many nor great. The Wyandotte is somewhat smaller, lays eggs which average smaller, and is perhaps a trifle more difficult to breed to standard requirements. On the other hand, its meat has a finer grain, it is hardier and more active, and its more numerous varieties give a greater range for the fancier to exercise his taste in selection. When carefully bred, both are splendid fowls and are worthy of every effort to maintain them at the point of greatest excellence. The complicated uniform and beautiful markings seen on the plumage of some varieties of Wyandottes excite unbounded admiration, and demonstrate the perfection to which the fancier's art has attained.

There are no better general-purpose fowls than the Plymouth Rocks and Wyandottes. The choice between the two must depend upon the taste of the breeder. Both should be better known, more widely distributed, and more carefully bred for utility qualities. In the production of table fowls of all kinds—broilers, roasters, and capons—they are unsurpassed, and in egg production they are capable of equaling the most prolific of the smaller breeds.—D. E. SALMON, *Chief of Bureau.*]

THE PLYMOUTH ROCK.

INTRODUCTION.

The introduction of the Asiatic-bred fowls into the New World had great influence for good among our so-called domestic fowls. The Shanghai, or original Cochin, and also the gray Asiatic fowl that was the original foundation stock from which our Brahmas were formed, brought increased size and better egg production, and their use as a cross upon our barnyard fowls created a desire for more and better poultry of true breeding.

In the efforts put forth for the advancement of quality in our farm-bred stock use was made, without any concerted understanding, of all the breeds that came to us from other countries. These new and highly esteemed fowls were mixed promiscuously with our home-bred fowls, the result of which gave us the foundation for all of our so-called American breeds. The original foundation stock that has been developed into our Plymouth Rock fowl came from an experimental cross of two birds that were united on account of their egg-producing qualities. The start of what came to be known as Jersey Blues and Rhode Island Reds began under like conditions.

The Brahma was the first breed of fowls that was credited to us as an American production; and, while they are classed as an Asiatic fowl, they are the outcome of great skill in handling the very crude original by our American fanciers, who have given over fifty years of attention to perfecting them. While Americans are given credit the world over for originating the Brahmas, these birds are grouped in our standard of perfection as belonging to the Asiatic class.

In the formation of the breed classes in the American standard of perfection all breeds and their subvarieties that have been made in this country by crossing and by the improvement of other crosses are classed as belonging to the American breeds, or families. These comprise the Plymouth Rock, Wyandotte, Java, and Dominque. They are the acknowledged breeds of our Standard, belonging to what are known as the American classes.

FAMILY COMB DISTINCTION.

The fowls of the American classes have their distinct style of combs, which is an emblem of family difference. The comb is so marked as to become the guide for the uninformed in selecting the families one from another. The Dominique is known as the Rose-Comb Dominique, from the fact that it has the so-called double, or rose, comb. It is a low thick comb, the upper surface of which is covered with small points, the rear end of which comes to a point called a spike. This spike in the Dominiques should be elevated at the end.

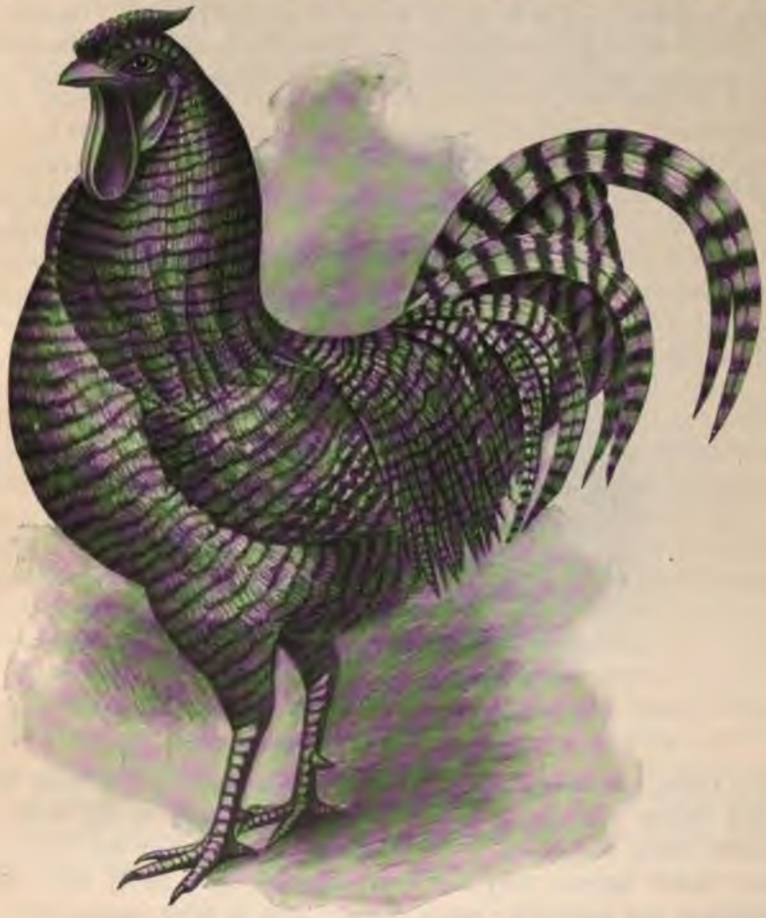


FIG. 212.—American Dominique male.

The Wyandotte also has the rose comb, but it is of a smaller pattern than the comb of the Dominique, and the end, or spike, turns down to follow the shape of the head; the points on top of the comb are not so prominent, nor is the spike so long as is proper for the Dominique.

The Plymouth Rock and Java have what is known as the single comb, which is upright and nicely serrated. The combs are so distinctly different as to be easily recognized.

THE UTILITY VALUE OF THE AMERICAN CLASS.

The American breeds are often termed the "general-purpose fowl," from the fact that when young they make the best of broilers and when matured a most perfect roaster. Their natural formation, inviting plumpness, makes them the desirable market poultry. In addition to all this they have the beautiful yellow skin so much sought after by our people; they are of quick growth as compared with other good-sized fowls, and as egg producers they average nearly the equal of any other breed; they lay a medium-sized brown egg of the very best quality; they are easily kept in good condition, and are among our best winter layers; they are very vigorous and hardy and able to withstand our most changeable climate with as little inconvenience as any known fowl.

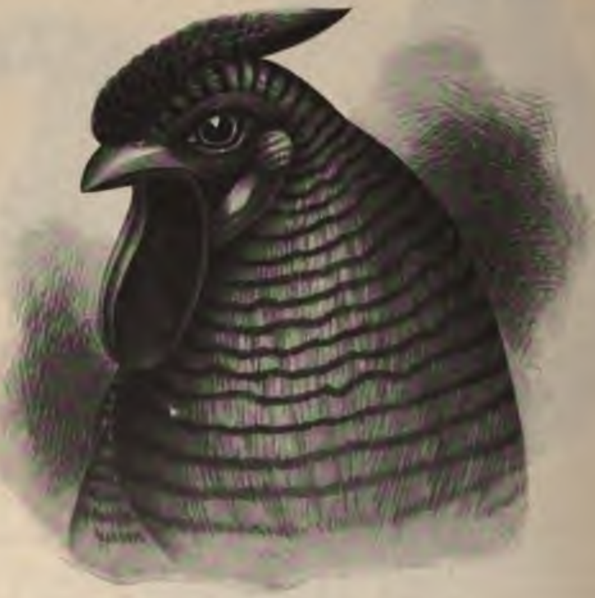


FIG. 213.—Head of American Dominique male.

The Rose-Comb varieties are least liable to injury by the extreme cold of our northern climate. At the same time the medium-sized combs of the other varieties are not so large as to be frosted when properly housed, as all poultry should be during the cold months of winter.

THE AMERICAN DOMINIQUE.

The American Dominique was well known in early days througnout New Jersey and eastern New York as a fowl of great merit as an egg producer. The eggs of this fowl graded A1 in the New York market, and as table poultry it had no superior. At that time the plumage was of a light-gray color, barred across with a darker shade; it had both the single and double comb, and the shanks and feet were yellow in color. It is claimed for this variety that it was brought to this country by both the French and the Dutch. This is of but little importance, for such birds might be produced at will.

The Dominique color is a combination of black and white. It comes as one of the results of crossing black and white fowls. The mottling of the Java and Houdan and the Ancora are other results of the same methods of mating pure black and pure white fowls together. When the poultryman of the past began selecting the Dominique for improving into a breed that would reproduce itself he preferred birds with the rose comb, the full sweeping tail, and the light-gray ground color barred with the bluish gray. In order that we may have a better conception of the top cross that produced our Plymouth Rocks, the American Dominique as seen in its prime will be described.

The general appearance of the American Dominique was not unlike our present large-sized Brown Leghorns. They were somewhat fuller in breast and deeper in abdomen. The female had a slight inclination toward both fluff and cushion formation; main tail feathers like our present Leghorns, only not quite so extended; breast full and carried rather forward, the male being quite like a large Brown Leghorn male in shape, with a tail almost as full as seen on the Hamburg. Their combs were rather larger than the Hamburg comb, but of the same form, type, and carriage, the rear end, or spike, turned upward, quite unlike the Wyandotte comb, which follows the shape of the head. They had a neck that was arched and covered with very full hackle plumage. Back broad and medium in length; in color and barring quite like an inferiorly marked Barred Plymouth Rock of the lighter shade of color. Such was the general make-up of the Rose-Comb American Dominique.

SINGLE-COMB FAMILY.

When we consider our American made or adopted breeds some must be mentioned that are not included in the list of so-called "Standard fowls." Some of them must be considered because they were used in creating a portion of our standard varieties, while others have had a position among our standard breeds, but have become obsolete from lack of admirers. At this time those only will be noted which belong to the single-comb family, for they alone will conform to the demands of our Plymouth Rocks. The Rose-Comb Dominique has been described first, the object being to keep it entirely separate from the single-comb fowls.

The single-comb fowls which belong to the American classes are these: The Java, the Plymouth Rock, the Jersey Blue, and the Rhode Island Red. All of these are classed as truly American—the Java by adoption and improvement, the others the result of crosses.

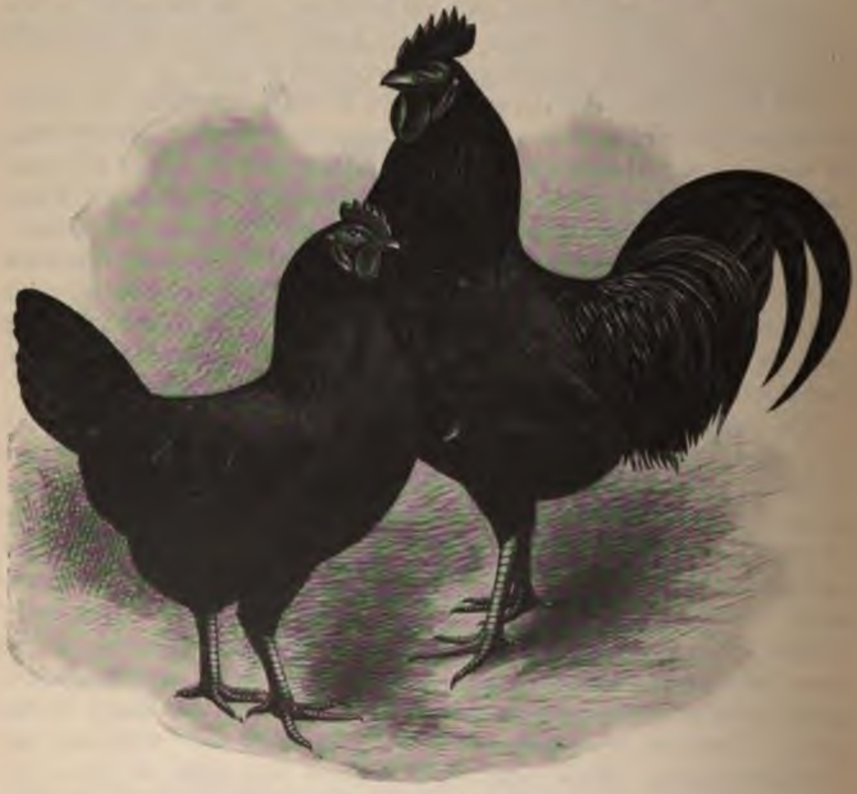
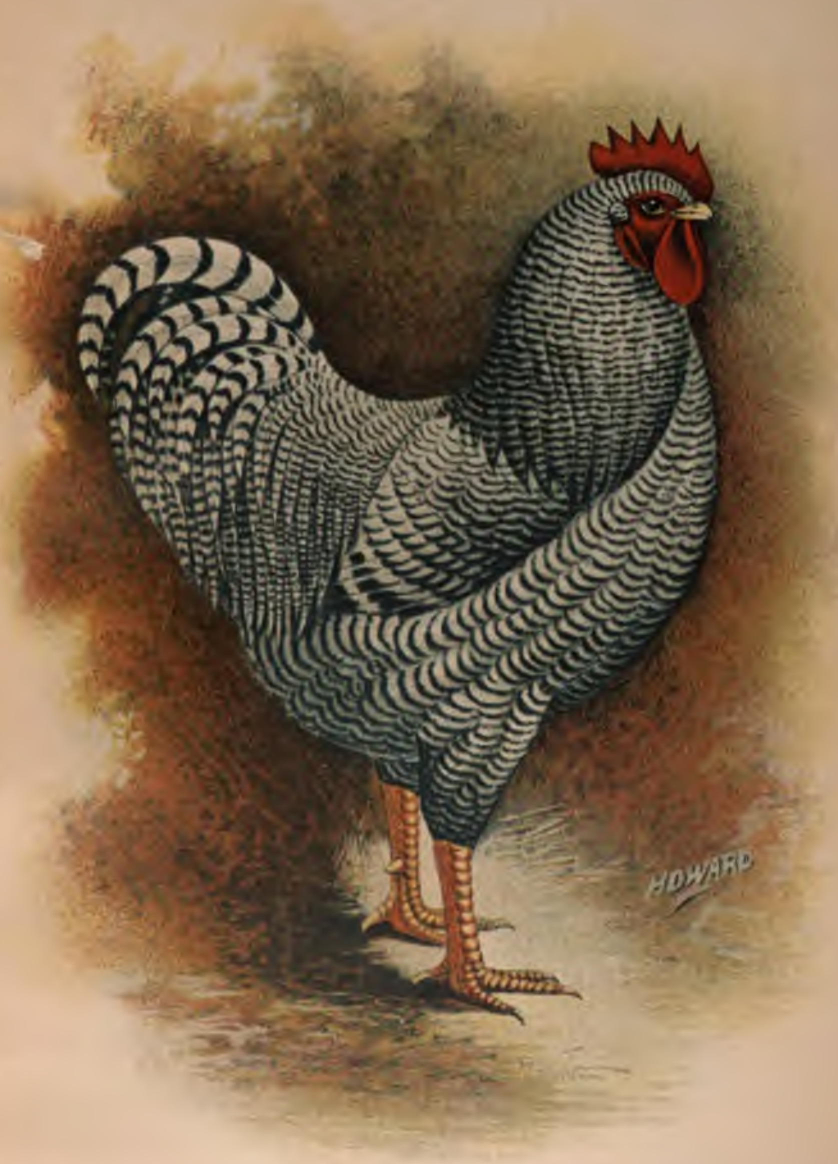


FIG. 214.—Black Javas.

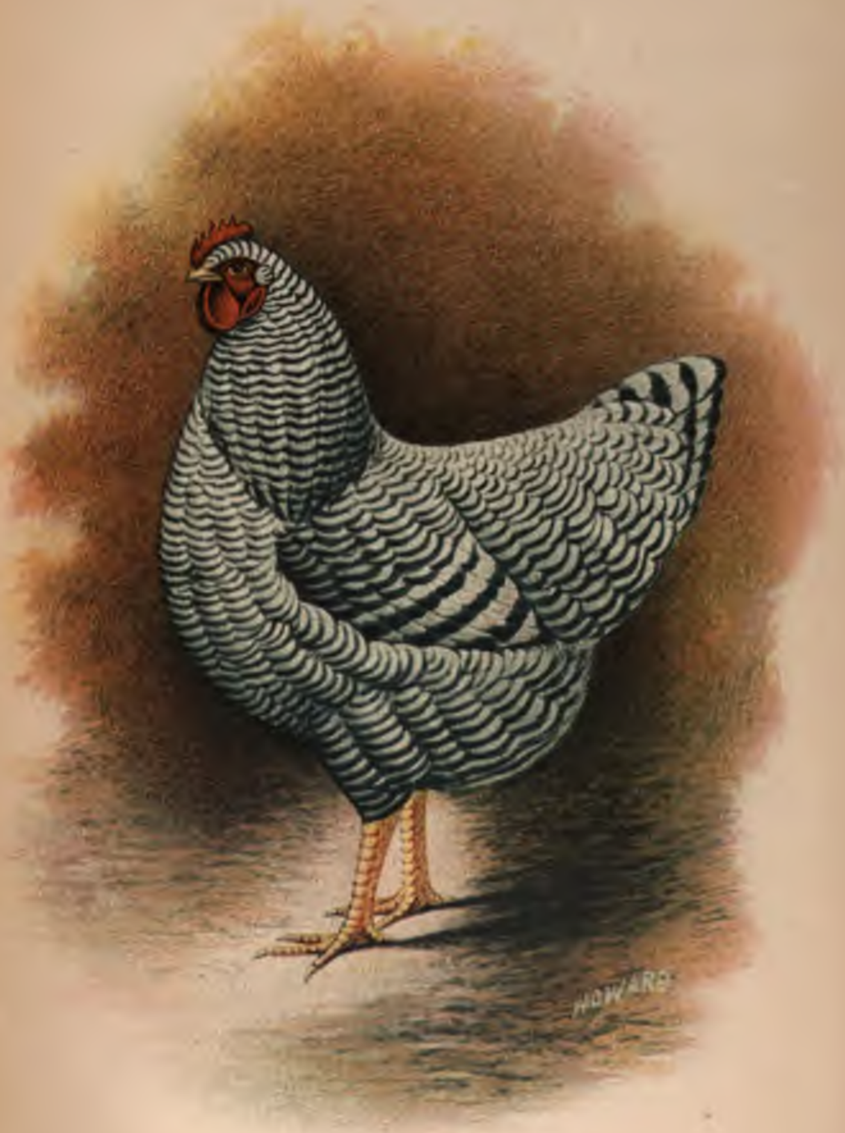
THE JAVA FOWL.

From all information obtained we learn that the early Java (which formed one-half of the original cross which produced the Plymouth Rock) was of Asiatic blood. The illustrations of what were then called the "Great Java" are quite similar to the illustrations of primitive Cochin China fowls, and these, combined with the written description of the Java fowl, point conclusively to Asiatic origin. The importations of these fowls were named after the ports from which they came; thus the same breed came to us under several names.

The Java is described as a large black fowl with single comb and



BARRED PLYMOUTH ROCK MALE.



BARRED PLYMOUTH ROCK FEMALE.

smooth legs, weighing from 18 to 20 pounds per pair. They are spoken of as being among the most valued fowls of the day, and their prolificacy in eggs suggested union with the Dominique, in the hope of gaining a better egg producer than either. Those who made the cross did so without a proper consideration of the result. Both of these breeds had already the highest reputation in this respect, and those who knew their valuable qualities exchanged stock, hoping that by intermingling the new blood they would gain an increased precocity in future stock.

Javas, as we now find them, are simply an improved or modified type of the original. Their general make-up is a long, broad, and deep body. They are the longest in back and body of any of our American breeds. As of Standard formation, they represent the most extended type, the Wyandotte filling the position of compactness, the Plymouth Rock the middle position—giving us three distinct formations. When we bear in mind that the Java type calls for the long back and body, no cushion, and but little inclination toward fluff, full tail and sickle feathers, we have before us the cause of many faults that are continually cropping out in our Plymouth Rocks. Much trouble and delay could be avoided were due consideration given to ancestral conditions when contemplating improvement.

THE PLYMOUTH ROCK.

When first produced no other name was needed; they were simply the Plymouth Rock fowls, and became well known under this title the world over. No other fowl has ever enjoyed equal popularity in this country, and we presume they are better known, and at the same time less understood, than any other fowl of minor reputation. More has been written about them than could be read in years, and there have been almost as many opinions and theories placed before us as there are writers. This has caused considerable confusion until the alarm sounded ascribing retrogression to the breed, when the attention of those best able to cope with the difficulty became attracted, and marked improvement soon followed.

There seems to be no condition, surrounding, or climate unfavorable to the Plymouth Rocks. Their constitutional vigor appears to have no limit. Where any fowl can live they will prosper. They stand confinement, and when allowed freedom prove excellent foragers. They are prolific in yielding medium-sized brown eggs of the richest flavor. Under all conditions they will produce fully as many eggs as any thoroughbred fowl.

Below is given their record in competition with others, from which it will be seen where they stand in comparison:

Yearly contest and calculated egg yield.

Breeds.	Tests reported.	Eggs laid in contest.	Average yield.	Weight per dozen.
	Number.	*Number.*	*Number.*	*Ounces.*
Barred Plymouth Rocks	262	173	150	23
White Plymouth Rocks	289	164	150	23
Single-Comb Brown Leghorns	277	157	160	19
Single-Comb Buff Leghorns		183	160	19
Silver-Laced Wyandottes		113	150	21
White Wyandottes		176	150	21
Rhode Island Reds		166	150	21
Crossbred pullets		129		

The first column gives the figures reported from a test under very high feeding and best possible attention. The second gives the figures obtained in selecting from over fifty lots, all reported monthly for a year. In the third column are presented the figures arrived at by calculation and accepted as nearly correct, as results that can be obtained under the best management.

This table records the egg yield of the different lots of fowls entered for competition in annual test, conducted by persons who have had to rely upon the statements of those owning and entering the fowls; and while we naturally hesitate to claim knowledge of their authenticity, at the same time the studious attention bestowed upon the work should assure us that the above figures are a fair average for the fowls competing.

ORIGIN OF THE PLYMOUTH ROCK.

The first fowl to bear this name was created by intermingling Cochin, Dorking, and Malay blood, the result of which was a mongrel of little real value. The knowledge of this inferiority brought an influence against what was to be the most popular breed ever produced. This we know from the fact that when the present Barred Plymouth Rock was first announced those best informed believed it to be the same as before, under other guidance.

Our present type of Plymouth Rocks is the outcome of careful handling of fowls secured from crosses made on the same lines as those reported to have been made in Connecticut almost sixty years ago, where they mated Rose-Comb American Dominique males with Single-Comb Black Java females. These same crosses, also others of like character, are claimed to have been made by persons who had obtained much the same results, but the Rev. H. S. Ramsdell, residing in Connecticut at the time, gives the name Woodstock as the town of their *origin,* and persons interested he names as Giles, Clark, Thayer, Spaulding, and himself. While this removes all doubt of the origin of this one strain of Plymouth Rocks, it can not detract any credit that may be due to the Messrs. Upham, Pitman, Felch, and others for the part they took in originating this type. However, be this as it may, the real point of interest is, How were they originated and advanced to their present position among high-class, standard-bred fowls?

There can be no reasonable doubt as to the make-up of the original cross having been as stated above, the product of which was grizzled gray and speckled. They were not of solid color, neither were they barred like the Dominique. In size and form they resembled the Java, while their color bespoke the influence of the sire. Those having the best color and single comb among those produced were selected and bred together as the real start of the present perfect fowl. Many subcrosses have since been made, some of which, it may be almost positively recorded, were the Cochin, Dorking, and Brahma, all of which had a tendency for future trouble for those who attempted to produce high-class Plymouth Rocks.

PLYMOUTH ROCK SHAPE.

No matter what variety of color they be, the form or shape of all must be the same. The presence of what are known as breed characteristics must be so strong as to stamp them with the unmistakable emblem "Plymouth Rock shape." The importance of this is shown in the fact that some persons can select a White Plymouth Rock from a White Wyandotte only by the difference in comb. This is the outcome of not demanding greater attention to type in the show room, where size, color, and comb are given more credit than is due and too little to the breed emblem—shape.

An effort is here made to make plain the proper shape of a Plymouth Rock and all sections, including the head and its belongings, are described as minutely as possible, omitting reference to color, which will be taken up separately.

The head of the male should be of medium size, rather round when viewed from the side, fairly prominent in front, back short and stout and nicely curved. The comb single, rather below medium, never large or coarse, but of proper size to give a finished, neat appearance in conformity with size of the specimen; it should be straight, upright, and free from all defects, a perfectly even surface throughout. The serrations must be regular and in uniform proportion, grading fore and aft from the center, where they are largest. The rule is five serrations. The points of the comb must be even and regular. The comb from the front, where it rests on the beak, should curve gracefully back, finishing with a nicely shaped heel, just forward of the juncture with the head and neck. It should form a half oval over the head, being highest in the center, gently declining either way, neither high in front nor in rear. A twisted, uneven, or thumb-marked comb is much despised; a perfectly formed comb, the crowning effect. A long head or beak is quite improper and should not be tolerated; it destroys the whole appearance of an otherwise handsome specimen.

Wattles should be moderate in size and nicely rounded and of even size and fine texture. When ill-shaped or uneven they are a deformity. Ear lobes should be neat, fine, and of equal size, nicely placed on the face below and in the rear of the eyes. A nice, prominent pair of wattles and ear lobes, if of good shape and texture, add much to the appearance of the head.

Eyes should be round, large, bright, and red in color. In the Standard the color is called a clear, rich bay. Weak-colored or pearl eyes are almost a deformity. They look bad, and in addition to their ill appearance, indicate poor breeding or delicate constitution. The eyes of a strong, vigorous specimen are usually very bright and striking in appearance.

A narrow or thin neck on a Plymouth Rock looks very bad. An abundance of plumage forms a full neck where it rests on the shoulders, the neck tapering gradually to the junction of the head. The strong full appearance makes the neck seem shorter than it really is, while a thin, narrow neck looks to be twice the length demanded. A well-proportioned neck, nicely arched from just back of the comb to the body, is the neck required for the well-proportioned specimen.

The back of the Plymouth Rock is one of the most important belongings. We quote in full the Standard description: "Broad, of medium length, and rising with a slight concave sweep of the tail; saddle feathers of medium length and abundant." This description calls for about the same style of back as is mentioned for the Brahma. Note that the Plymouth Rock back is fashioned after that of the Brahma, the Wyandotte back resembling that of the Cochin. No cushion is called for in the Plymouth Rock, while for the Wyandotte male a broad, full saddle is required, the female being slightly cushioned. If these distinctions of back were strictly adhered to the Plymouth Rock form would be more distinctive.

The broad back of medium length (medium as between the long back of the Java and the short back of the Wyandotte) is essential. Nothing short of this description fills the Standard demand, and a demand of so much importance should be most strictly adhered to. If this description were well understood and followed to the letter, much of the present confusion as to type would disappear.

Tail formation is quite a factor in the proper finish of back. If the main tail feathers are strong and fairly well spread they help to build up the back to the proper ending in accordance with the Standard, but when these feathers are contracted or narrow, they allow the saddle plumage to gather and form the narrow or pinched appearance instead of the proper sweep to the tail. They also spoil the shape of the tail itself, giving a tapering appearance from the shoulders back.

The tail of the Plymouth Rock, in formation and finish, resembles somewhat the tail of the Brahma. The carriage of each is about the same, and the sickle feathers and coverts are fashioned much on the same lines. Therefore, when it is stated that the Plymouth Rock back, including the tail, is fashioned after the Brahma, it is hoped that the proper formation of each in accordance with the Standard is properly understood as the meaning. This positively prohibits the Cochin form of back for either.

The under portion of the Plymouth Rock, including breast, under part of body, abdomen, and legs, is of equal importance. The broad, deep, and well-rounded breast gives these fowls their value as table poultry. The notably rounded keel bone that extends well forward helps to build out the foundation for plenty of breast meat, while the strong, full abdomen provides the space for eggs in the female. But both the male and female are confined within the demand for moderately full fluff only, while in the Wyandotte considerably more fluff is allowed. Here, again, is the fact that while the Cochin form is allowable in the Wyandotte it must not be present in the Plymouth Rock. Wings of medium size, broad and full at the shoulders, help to spread the hackle and widen the shoulders, giving the strong, broad appearance as the specimen faces one, while close, narrow wings help to give the narrow, inferior appearance, such as is often found on what are called undeveloped specimens. The strong, prominent wing point, or bow, which is well built out with under muscles, adds very much to the appearance of the fowl.

A good, large thigh that is supported by stout, well-proportioned shank of medium length, good feet and toes compose the proper leg for the Plymouth Rock. A long leg, thin shank, and ill-shaped toes are incorrect, for without the proper foundation a fowl of such build as the Plymouth Rock could not have that finished appearance demanded for it.

A FEW POINTS CONCERNING THE FEMALE.

While the general description given above touches upon the form of both male and female, there are some features of the female which require a more special notice. The most important of these is the tail. This should be so carried as to form a continuation of the back. It should not be so elevated as to form an angle in the back, nor should it droop in the least. To give the best appearance to the back, the main tail feathers may spread out at the base, but should come together at the point.

The most striking feature of a well-formed Barred Plymouth Rock female is a beautiful head and neck, which are most difficult to obtain in any approach to perfection. In many instances the head is large and heavy in appearance, and the barring of the neck gives rather a spotted appearance on the surface, which should show true barring. When of proper make-up, the head is nicely formed and well set on the neck; the beak should be short, strong, and nicely curved, so as to present a finished appearance; comb should be neat and rather small, but well defined and of suitable proportions to conform to the head; eyes bright and clear, bay in color; neck nicely curved, gradually widening toward the juncture with the shoulders. This graceful head and neck make a most attractive appearance.

The medium length as demanded for back furnishes correct proportions for a graceful sweep or incline of back toward the tail, as described. This description allows the beautiful back formation that should be free from all appearance of a cushion, for the true Plymouth Rock female should be free from cushion on back and have only a slight showing of fluff. While they are required to be well feathered about the abdomen, there should not be a fluffy formation.

Back, breast, and body should be well rounded and full at point of breast; the wings closely set against the body and strong at shoulder; main tail feathers standing at a slight incline as if they formed the end of the back. They should be so spread at the base as to form a graceful support to the back without causing a too full appearance at point of wing. The under-filling of the tail should be prominent.

The marking of the Barred Plymouth Rock female, when properly distributed, is grace itself. Beginning with the close, narrow bars just back of the comb, and gradually broadening and widening as the tail is approached, there is formed what might be called circles of grayish blue when seen under good lights and conditions. Much depends upon the evenness of barring and the well-defined lines between the two colors; for when either encroaches upon the other the greatest beauty is wanting. This combination of light and dark colors creates the so-called blue tint of the Barred Plymouth Rocks. The beauty depends entirely upon the purity of color and the graceful formation of the bars.

The beak and shanks of the female should be true yellow; but it is a fact that many more have dark spots than have the true color. These dark spots come from the early Java cross, no doubt, and will continue with them for years to come. The shanks should be strong and well placed, with no inclination to turn in at the hock. They should be wide rather than narrow at this point.

THE BARRED VARIETY.

We have never seen an authentic proof that there is any other native North American fowl than the turkey that has been domesticated. All of our poultry, both land and water fowls, which are classed as domestic poultry, came to us from other lands. Those we have are all the result of careful crossing, mating, and improving. We have always paid the strictest attention to color demands, often at the sacrifice of shape. This is a natural result almost sure to follow close breeding for color. Good, even color of plumage can be procured and maintained in highest perfection only by close line breeding, a natural result being more or less loss of size and good form.

Line breeding, or inbreeding, is an absolute necessity to produce a certain type or color. There is no other way to produce either with any certainty; and, while we are thus guiding our stock into new conditions, we are as surely reducing their size and injuring their shape and vigor. The only sure way to maintain all is to have more than one line of breeding stock, so as to be able to invigorate one by the other with as little injury to color as possible.

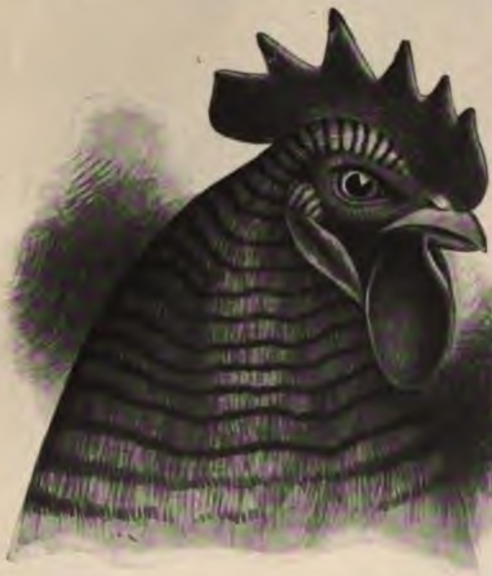


FIG. 215.—Head of Barred Plymouth Rock male.

Our demand for perfection of color and barring in our Barred Plymouth Rocks has driven all those who produce for exhibition purpose to close line breeding and to the double mating system. These two methods have proved successful for color, but at the same time have not added more grace or better form to the fowls as a breed. In this particular it has been claimed that our Plymouth Rocks have declined. But we may feel assured that the ability of our American breeders will soon remedy this error, and we shall have far better form than before, in addition to perfection of color.

The color demand of the Standard is bluish gray, barred with narrow, parallel lines of dark blue, approaching almost to a positive black. The barring is to be close in all sections of the body, and on neck and saddle hackle narrower and closer than in other sections. The barring must positively show the entire length of the feathers in all sections when they are not mostly composed of down. In the primaries, secondaries, and feathers of the tail the barring is to be wider than in other sections. The shade of surface color is to be nearly or quite uniform throughout.

The most perfect colored Barred Plymouth Rock is one whose color is so perfectly blended as to present to view the attractive blue shade so continually talked of as belonging to them, but so seldom seen in anything like perfection. When the ground color is of a clear bluish gray and the modified blue black, so called, and the lines between the two shades are clear-cut and distinct, the combination, under proper light, reflects the blue tint which is so desirable in a high-class specimen.

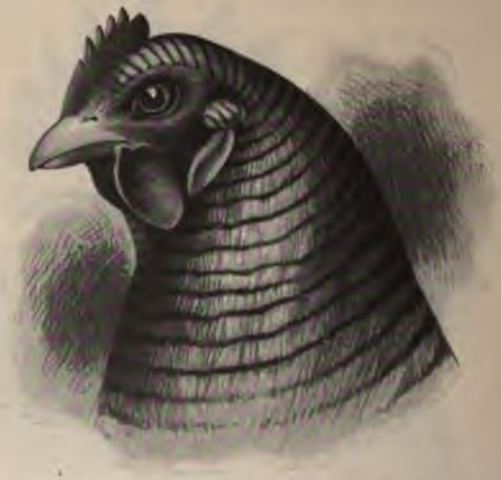
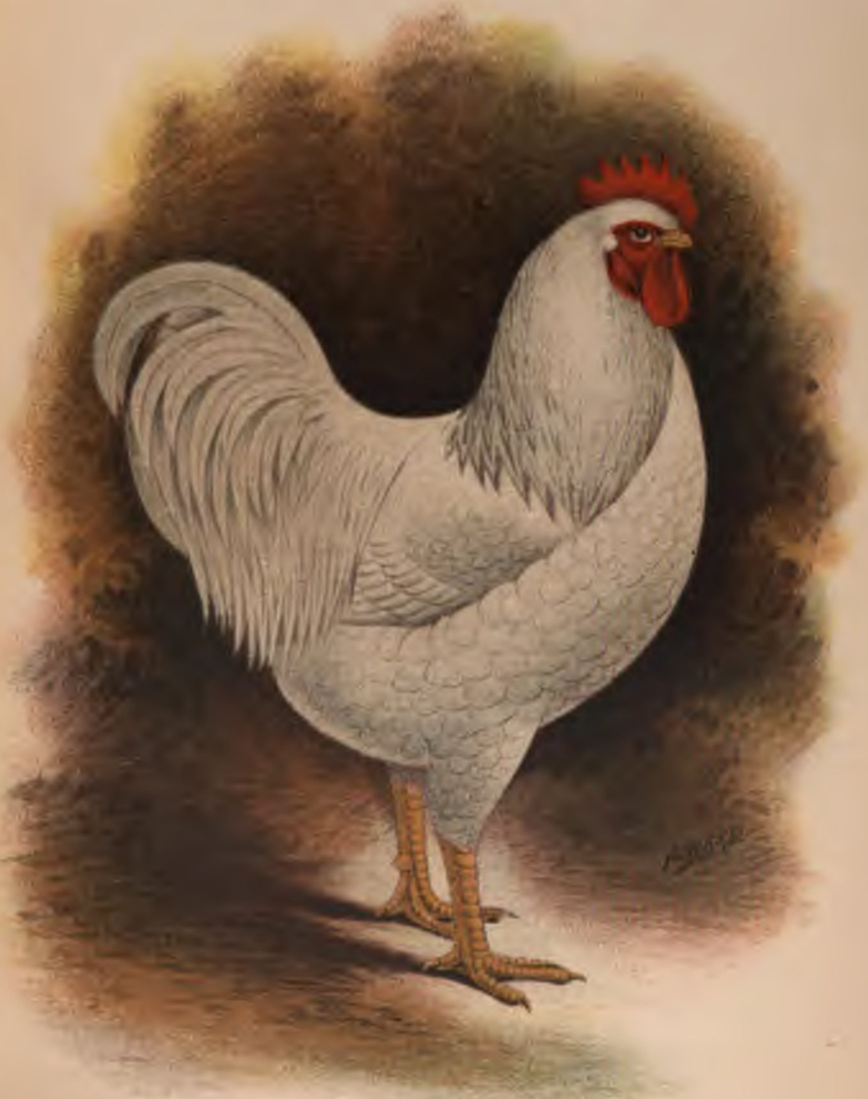


FIG. 216.—Head of Barred Plymouth Rock female.

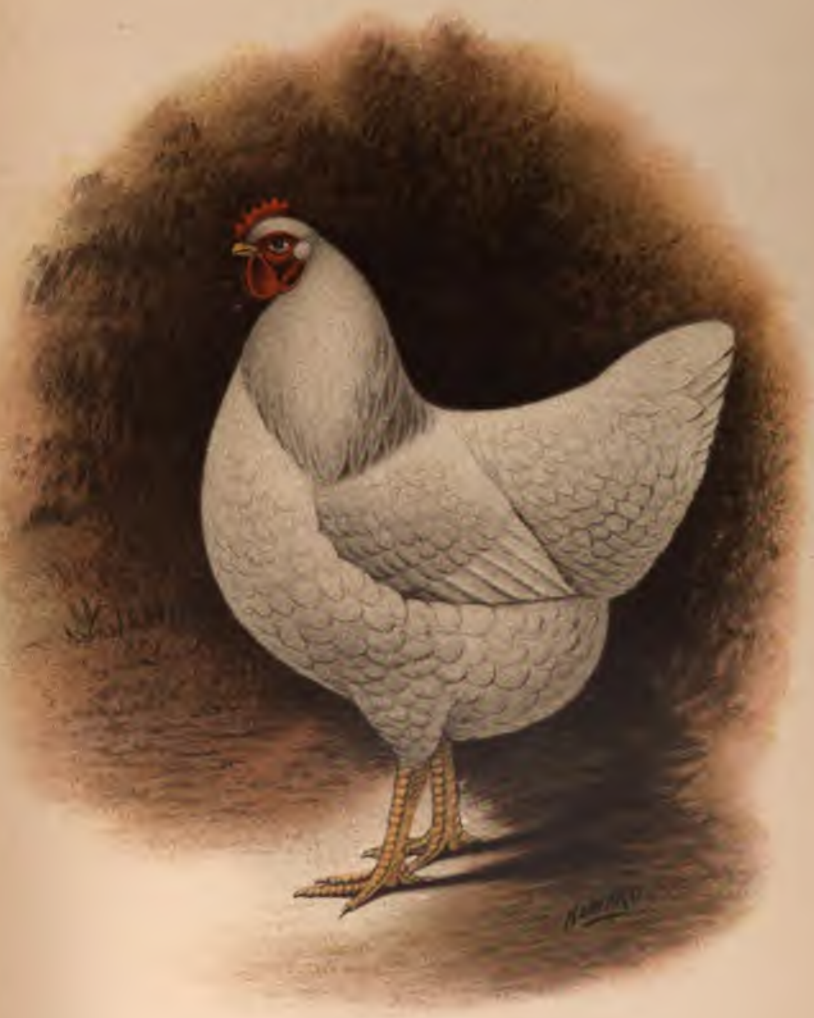
The crowning beauty of the Plymouth Rock is its purity of color. The two shades, one light and the other dark, must each be pure and true to its color and positively free from any tinge of foreign color. This, to begin with, is the fundamental condition when selecting for proper coloring. When we have this purity of color, perfect surface color is assured.

PROPER BARRING.

There are two very important factors in the problem of barring often passed over without due attention; that is, the narrow and parallel lines of dark blue. The bars must be narrow and straight, those of the neck fine and distinct. Spots on the surface of the neck plumage are not bars. The barring of the neck must entirely cross the feather, barring it just as perfectly as the most perfect feather of the body.



WHITE PLYMOUTH ROCK MALE.



WHITE PLYMOUTH ROCK FEMALE.

Or, in other words, fine lines of the darker color must extend across the light shade, as straight as if made with mechanical precision, from the point of the feather down close to the skin in perfect regularity. The lines in the smaller feathers close to the head are the finest, and they grow wider and more pronounced until they reach the lower portion of the hackle, which are about the same as the saddle plumage.

The saddle plumage of the male is another section that has the narrower lines of barring. While these lines are not so fine as in the neck plumage, they conform to one another in their gradation and style of lines. Often the most beautiful barring is present in this section. The prevalent defects found in these sections are the V-shaped bars and the broken lines, where the quill, or the shaft of the feather, passes through them. In the latter the line, or bar, on one side of the quill will be its own width higher on the feather than the continuation of the same bar on the other side, thus: $^{-+-}\,_{-+-}$. These two defects are quite serious, as they destroy the uniformity of surface bars, which

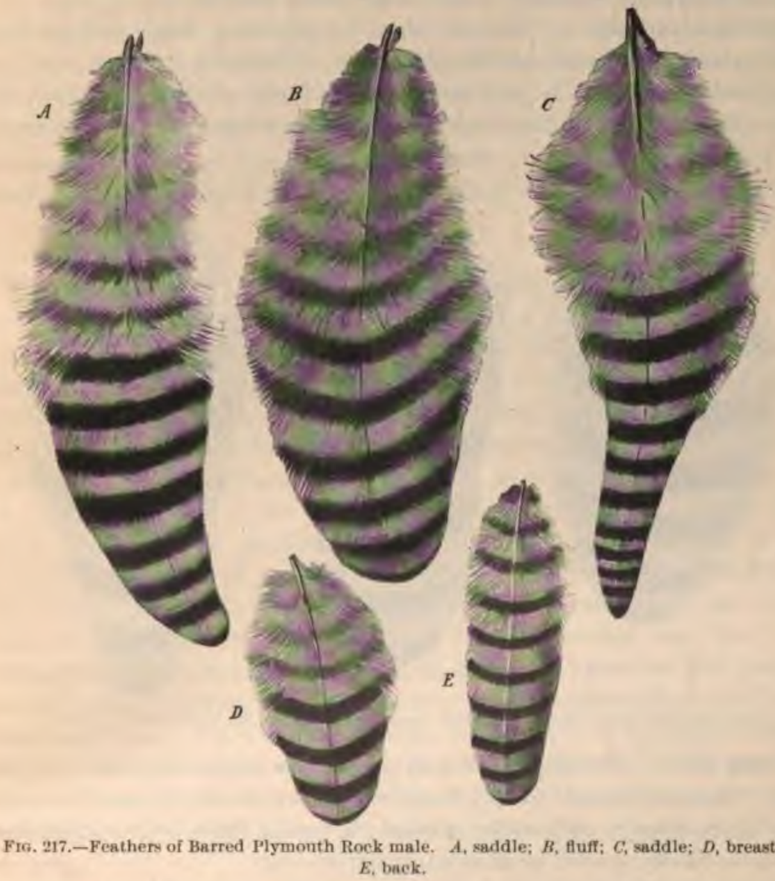


FIG. 217.—Feathers of Barred Plymouth Rock male. *A*, saddle; *B*, fluff; *C*, saddle; *D*, breast *E*, back.

should parallel each other, and, in addition to this, count against them in undercolor.

The body plumage, including breast, of both male and female is barred alike, being broader and more striking than in neck plumage. Each feather usually ends with the darker shade. When this is not the case the specimen is frequently too white for exhibition. It is especially important that the lines in these sections should be very uniform and straight. The dividing line between the light and dark shades must be very sharp and entirely free from bronzy shading.

The back plumage of the male should conform in shade and barring with its own hackle and saddle plumage. While the barring is not so fine, neither should it be so heavy as to look out of place between the two. This portion of the fowl is one of the weakest color sections of the male bird. Metallic black will often show like a network over the back. Both red and bronzy feathers will come to the surface; and here, more than in any other section, is found the white undercolor. All these faults should be absolutely driven out.

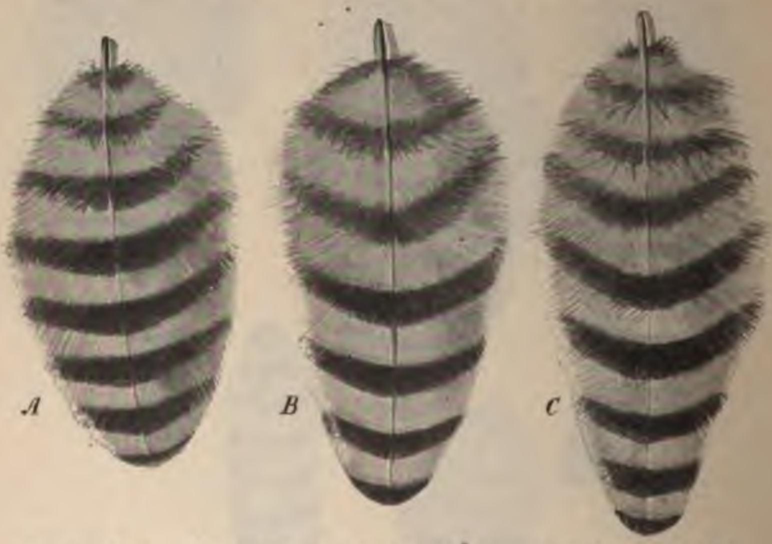


FIG. 218.—Feathers of Barred Plymouth Rock female. *A*, neck; *B*, shoulder; *C*, back.

The main tail feathers of both male and female should have the perfect barring, but should be considerably wider than in any other section. Here, again, is often present the broken bars, as shown above, and being so much broader they look the more out of place. The clear-colored, regularly barred tail feathers add considerable finish to any specimen, while poor color and irregular barring in the tail feathers, being always in sight, have an unfavorable bearing upon the other sections of the bird. One of the most beautiful effects of plumage comes from a profusion of handsomely marked feathers filling in underneath the tail.

This not only vastly improves the general appearance of the fowl, but gives a perfect finish to the tail.

Wing bows of male birds are often defective. Here the barring is often weak and ticked, and the color of the flights of both male and female often have the appearance of gradually merging the one shade into the other. A wing with flights equaling the tail or secondaries in color and barring is quite uncommon, a condition which seems seldom removed.

To sum up the subject of surface color: Whether it be of the very light shade sometimes seen, or much darker, or whatever shade the specimen may be, a uniform shade of color should prevail throughout the fowl. Let it not have a light neck with a dark saddle or back; neither will it do to have one shade on back and saddle, including tail, and another shade on breast. "The shade of surface color must be nearly or quite uniform throughout" to meet the Standard demand.

UNDERBARRING.

The barring must show on the entire length of the feathers in all sections when they are not mostly composed of down. This is the law for undercolor or barring, according to the Standard. Or, in other words, all feathers other than the fluffy feathers that cover the posterior portion of the fowl shall show positive barring to the skin. This with some is taken to mean that the barring of underplumage must be quite as distinct as the surface barring, which is considered erroneous, it not being the intent of the wording of the Standard, as it simply calls for a "barring that positively shows itself the whole length of the feather." In this case a positive showing does not demand the same intensity of color under as upon the surface. While this is the intent of the Standard, at the same time the limited number that has been produced with underbarring approaching the distinctness and perfection of surface barring has attracted the greatest admiration of all who have seen them. Such instances point to this style of barring as being very near to perfection, as gauged by public opinion. If it is possible to produce such intense underbarring and hold the surface color clear and clean-cut, we shall assuredly have an attractive color and style of marking.

The weak points for underbarring are on the back of both male and female, and just forward of the tail of the male. Not very long ago the surface of wing and the plumage of thigh of both male and female were quite deficient, but this is now much improved. The greatest trouble experienced with an excessive underbarring is an injury to surface color. The much barring to the skin carries with it such a predominance of strength in the darker shade as to influence the surface color undesirably and to show the metallic black rather strongly on the males.

When a clear, clean undercolor, nicely barred to the skin, quite plain enough to be readily seen, is obtained, the Standard demand is fulfilled. At the same time the most positive preference is shown, by all who are well informed, for the positive barring, provided it is clear, clean, and regular. Often those who are not fully acquainted with the methods of judging fail to understand why a fowl which fills the Standard demand in undercolor should be discounted as against the one with the better barring. The fact that one has better barring than the other must place it in advance on this point, at least.

With some, the wing flights are classed as undercolor, or barring. These are the most difficult to control and to bring within the desired color demand, and few specimens are ever seen that have flights that could be considered within the Standard line. Seldom do we see one in which the lines between the two colors are distinctly drawn. The tendency of the colors to run (as the saying is in the dye shop) seems to invade the flights.

MATINGS.

The formations, as shown in their origin, give the greater strength of color to the female. The so-called top cross of the lighter-colored male with the darker-colored female still casts its influence toward the too dark female and the too light colored male. This natural condition, it is claimed, renders it quite impossible to produce the proper exhibition color males and females from the same pair. For this reason what is called the double-mating system has come into general use.

There are those who claim to produce exhibition males and females both from the same mating. While this is done to a certain extent, the facts are that by far the greater portion of our best exhibition Barred Plymouth Rocks are produced by the double-mating system. One of our most successful breeders states that each year his single-mating system comes nearer to achieving the same success as has been obtained heretofore from the extreme double matings.

THE SINGLE MATINGS.

When we speak of single matings for producing Barred Plymouth Rocks the possibility of being able to mate a pair, trio, or pen that will produce both males and females of high-class exhibition qualities is implied. If it is possible to select a pair that will produce both males and females of proper Standard color and shape, that have the very desirable surface color and barring, also the requisite amount of undercolor, then we have succeeded on the single-mating system. Until this is accomplished the single-mating method is not a success.

A Standard colored male mated to three or four hens, some of them light in color, some dark, and some medium, might produce both males and females of good quality. But that is not single mating. Single mating, in the strictest sense, is producing both males and females of the highest quality from a single pair. It must be the result of a true single mating of one pair of fowls, not a pen, nor yet a trio.

THE DOUBLE MATING.

This is the selection of what are called pullet-breeding females and mating them with pullet-producing males, for the express purpose of producing exhibition colored pullets; also the selection of cockerel-breeding females and mating them with cockerel-producing males for the purpose of obtaining exhibition cockerels. This is what is known as double mating.

For the production of pullets under this method, select females of perfect Standard color, in barring and underbarring; be careful as to clear, clean-cut barring that is absolutely perfect in all respects, so far as it is possible to obtain it; pay strict attention to the fine, close barring in the neck; see that this is really and properly barred and not marked with broken or V-shaped lines. Also look well to the tail, flight, and secondary feathers. Spare no pains in selecting the breeding females, taking only such as will satisfy thoroughly your desire were the same condition of plumage inherited by their future chicks.

With such females place a male of considerably lighter color than they are. Some use very thin-colored males. These very light-colored males with such females as are above described will produce light-colored pullets. Others take what might be called a medium shade and gain the medium color in females. The shade in this way can be partially guided in your pullets. The fact to be borne in mind is that with such females the lighter in color the male used the lighter the pullets will be. No matter what shade of color is preferred, let it be remembered that the male used for producing pullets must be lighter in shade than his mates and that his barring must be as near to perfection as possible. He must be well barred to the skin and free from all tendency toward white undercolor in back. When success in producing high-class exhibition females is attained and a line established that will produce them year after year, the males from these matings are most valuable as pullet breeders.

DOUBLE MATING FOR COCKERELS.

For producing males that will win in strong competition, select fine large females in shades of color considerably darker than Standard color. These females must be entirely free from any bad color. They must have fine, close, regular barring, running to the skin. It is quite useless to hope to produce good males, or in fact good fowls of any kind, from inferior females. Better by far to give all the time and attention to one pair or trio of real meritorious specimens than to hope for success that can never come from inferior stock.

After selecting these darker-colored females, place with them the finest male possible to obtain—one of perfect Standard color, marking, and undercolor. The nearer he comes to perfection in every section, the better will be his sons.

In all these matings, the barrings must be of straight, narrow type; they must be true and distinct in all the specimens used; the light-colored males must be as true in this respect as the darkest female. Each and every specimen must conform to all the demands of the Standard, as well as to the style and manner of barring.

GENERAL DEMANDS.

No fowl of any kind that is not true to its breed characteristics should be used as a breeder. The first requisite to be considered in selecting either a male or a female for these matings is to have present in each specimen a true Plymouth Rock form of the highest degree. It should always be borne in mind that the male largely influences color, while the female gives the size and general formation. A breeder that has a poor comb or deformity of any kind should never be used, and the strictest attention to proper color of eye, ear lobe, beak, legs, and toes should be given. By following closely these suggestions and selecting, when it is possible, specimens that have been bred in line for years for males or females, as the case may be, success in producing high-class Barred Plymouth Rocks should be attained.

WHITE PLYMOUTH ROCKS.

The White Plymouth Rocks are (so-called) sports from the Barred variety. There are two causes found for such a variation in the formation of the breed—first, the Black Java was part of the original foundation stock, and all solid black fowls are apt occasionally to throw white chicks; and, second, the cross of the white Asiatic fowl, for the purpose of enlarging the size, clearing the plumage, and increasing the size of their eggs, might be expected occasionally to crop out in the offspring. It is not surprising, therefore, that white fowls have been occasionally produced; the greatest surprise in their appearance is their good Plymouth Rock form.

THEIR ORIGIN.

About 1875 or 1876 Mr. Oscar F. Frost, of Monmouth, Me., had hatched from eggs laid by Barred Plymouth Rocks some white chicks that grew to be good Plymouth Rocks in shape, but white in color. These are said to have been the first that were ever mentioned up to that time as having made an appearance. As soon as it was admitted that such was the case, others through the country claimed to have had the same experience in their flocks. In almost every case they seemed to come from either the Essex or the Drake strain of birds.

The originator of what was known as the Essex strain of Barred Plymouth Rocks claims to have crossed into his flock a fowl called the White Birmingham. It is claimed by some that this is the true reason for this strain producing white fowls. There was considerable activity in an effort by those who disliked the idea of allowing a white fowl to be called a Plymouth Rock to have them named Birminghams, but the satisfactory establishment of their descent from the Plymouth Rocks, the evidence that they reproduced their qualities, and the presence of as good form as could be shown in the Barred variety, secured to them their right to the family name.

When we speak of this variety as a sport from the Barred Plymouth Rocks, we mean that eggs laid by the Barred variety produced these white specimens, and that this was simply the reappearance of ancestral characters through the action of well-known laws of heredity. It is asserted that it is not an unusual occurrence for some lots of Barred Plymouth Rocks to produce solid, or almost solid, black fowls. This also might be expected, since there were black as well as white breeds used for foundation stock.

When solid black fowls produce pure white offspring, these are called albinos. This is looked upon as a weakness in color of the parent birds. But when any made breed shows a tendency to "throw back" to any one of its ancestors it is called a reversionary tendency, or the going back to an ancestor. In this case the white specimen took the color of one of its ancestors and held to the shape of its immediate family.

COLOR CONDITIONS.

We must not have the impression that the first of these white sports had good clear color, for they had not. It took several years of great care in mating to get them started toward breeding true. This, however, is not remarkable, since our very oldest known breeds will not breed absolutely true at all times. A new variety could not be expected to do better than those which have been carefully selected for many years.

As the result of patience, skill, and good judgment we now have the White Plymouth Rock, which is of as good form as can be found in the Barred variety. They fully equal them in size, and their color is as pure white as is seen on any fowl. Many of them are pure white in plumage, with beaks, shanks, and feet of beautiful orange yellow, giving the combination of color so popular in this country.

PROPER MATINGS.

As stated before, all Plymouth Rocks, no matter of what variety-color they may be, must have the same shape. There is but the one true Plymouth Rock shape. An effort has been made to state plainly in previous pages just what this should be, and the first and most essential requirement is that all specimens of the white variety that are used for breeding shall be most perfect in Plymouth Rock shape. As there are but two conditions of quality to be considered—good shape and pure color—it is of the greatest importance to have them both as near perfection as possible.

Fine large specimens of most perfect Plymouth Rock shape which are pure white in color, and whose head, comb, and eyes are right up to Standard demands, are the only kind worth consideration for breeding purposes. With these they must also have good, richly colored, yellow beak, shanks, and feet. It is simply folly to hope to produce good high-class show specimens from under-sized, ill-shaped, poor-colored specimens. If simply handling them for eggs, select the best egg producers and keep them; but if breeding for exhibition, do not waste time trying to succeed with even fair quality. To succeed it is necessary to have the very best.

WHITE AS A COLOR.

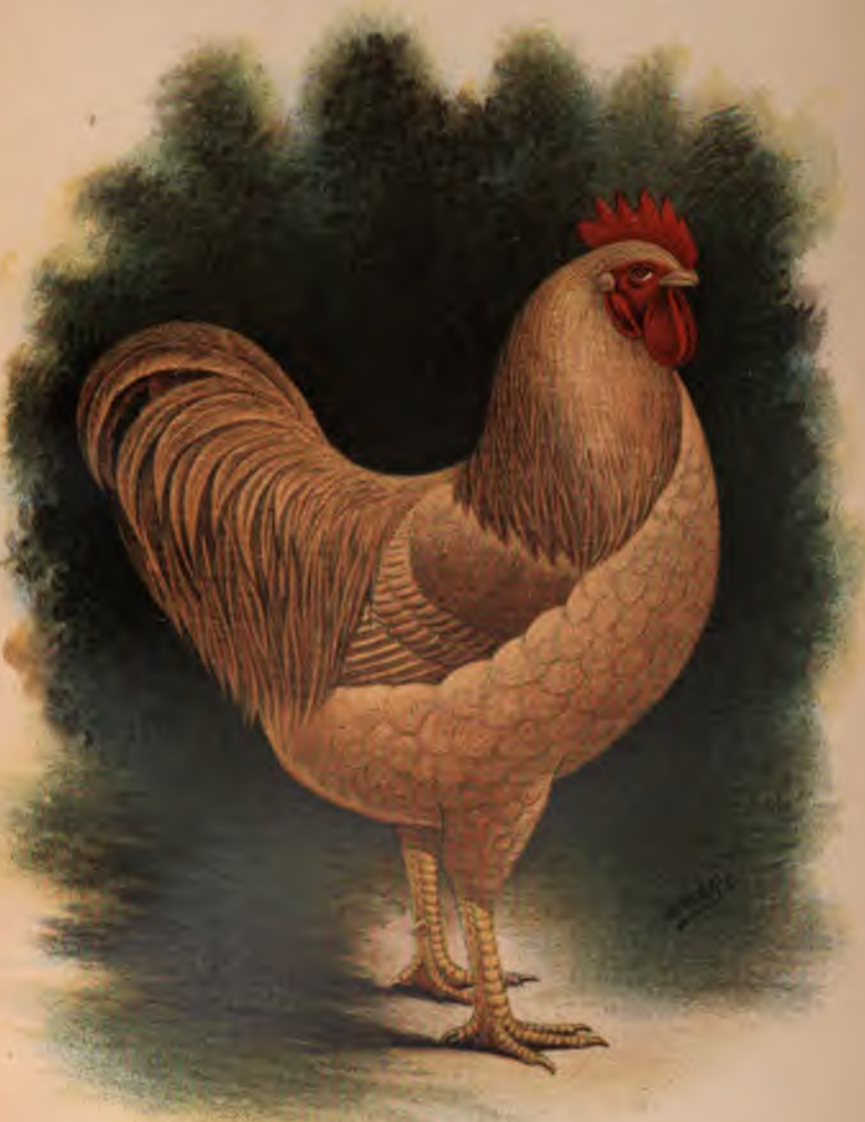
The pure white plumage of a fowl is quite as difficult to obtain in perfection as any of the variety colors; yellowish or creamy tints, also black specks, will show in the feathers of the very best strains. Often when the surface plumage appears white, the undercolor will show the creamy tint. This discoloration is often prevalent in the quills of the wings and tail feathers, also in the back just in front of the tail. The presence of the creamy or yellow tint destroys a specimen for either breeding or exhibition purposes.

White fowls that have this yellowish cast in plumage are usually the most vigorous of the flock, while those that are absolutely pure white are often rather delicate as compared with the others. It is frequently the case that sprinklings of black will be found in parts of the plumage of the whitest specimens. These small spots of black look like sprinklings of pepper on some of the feathers. This most usually shows itself in wing flights or on back plumage. At times solid black feathers will show themselves; usually they crop out on the back or on the body just under the wing bow.

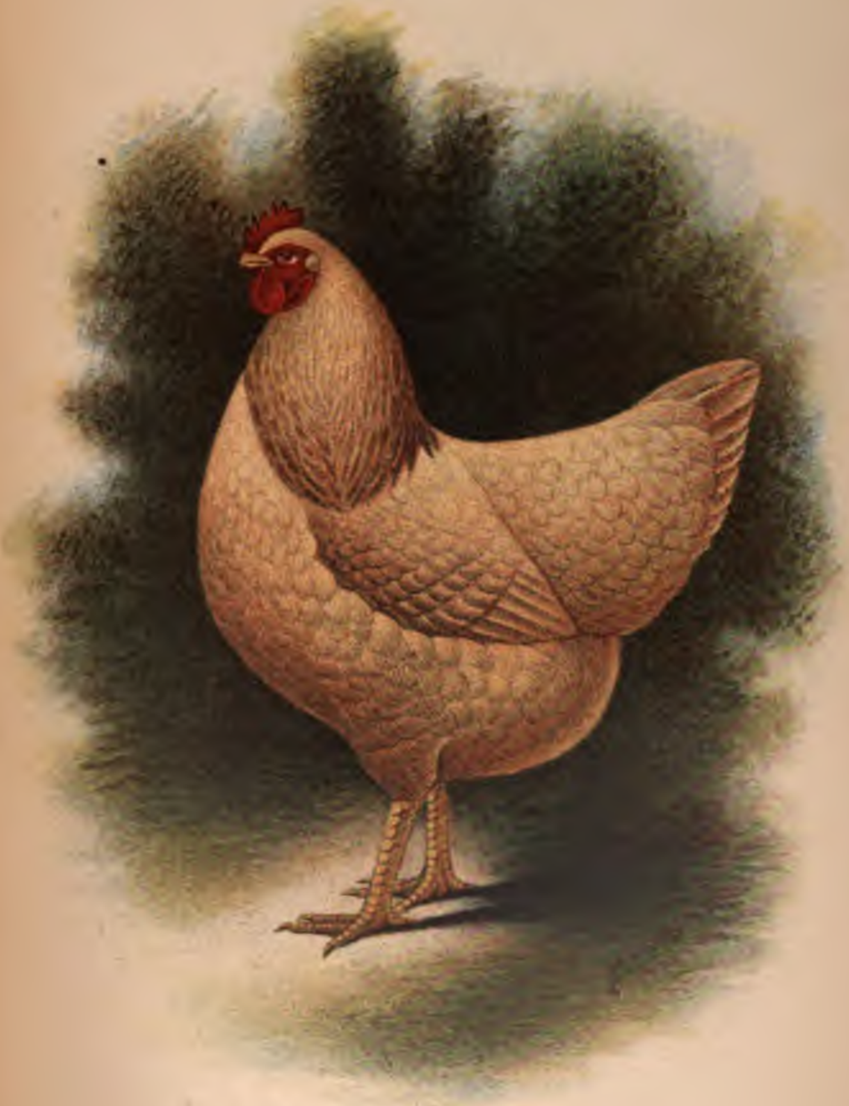
When selecting breeders for market purposes, for both eggs and market poultry, the largest and most vigorous specimens, without regard to yellowish cast in plumage, should be selected. Size, strength, and constitution should be the first consideration for producing stock for eggs, broilers, and market poultry. But when selecting for production of exhibition specimens use only those that are absolutely white to the skin, including quill feathers.

BUFF PLYMOUTH ROCKS.

The whole fraternity of poultry fanciers thought the advent of the new white varieties marked the full tide of success with fowls; but



BUFF PLYMOUTH ROCK MALE.



BUFF PLYMOUTH ROCK FEMALE.

when the facts as to new buff breeds shone upon us, all interested in fancy fowls, to a greater or less extent, went, as might be said, color mad. Even to this day men will argue the question as to the shade of color, and present as samples of true buff color specimens ranging from lemon yellow to snuff brown, some one calling each shade the proper color.

It is acknowledged that there have been two original strains of the Buff Plymouth Rocks—the one called the Wilson strain, the other the Fall River strain. The Wilson strain originated with Mr. J. D. Wilson, of Worcester, N. Y., from Buff Cochins and Light Brahmas. The Fall River strain was produced by Mr. R. G. Buffington, Dr. Aldrich, and others, at Fall River, Mass., by crossing Rhode Island Reds and White Plymouth Rocks; also from selected Rhode Island Reds that had fairly good Plymouth Rock shape and buff color. The Rhode Island Reds selected for this purpose had more or less Plymouth Rock blood in their veins.

These early productions had black tails, dark flights, almost red body color, and very red wing bows. The Wilson strain had the better size and color; the Fall River strain better form. From the union of the two, those interested have produced a fowl that has the true breed characteristics, also good size and color. Few varieties have advanced so fast as these in real quality of both form and feather.

It is not unusual to see male birds of true color, through and through, while in females true color is so common as to be practically established; yet in some cases the color is thin and washy, and in others too deep or too red. But even with these faults their handlers have shown great skill in bringing them to their present condition in so few years, notwithstanding an undercurrent of hereditary forces tending toward many shapes and colors which came through their original make-up.

It can not be too strongly emphasized that all Plymouth Rocks must have the same shape, form, and breed characteristics. That the shape makes the breed is ever true, while color is simply the emblem of the variety. In all solid-colored fowls we have the right to hope for better form than in particolored ones. For this reason we should expect the most perfect Plymouth Rocks in this variety.

In mating these fowls for producing the highest-class specimens, first of all select good size, vigor, and Plymouth Rock shape, always looking well to the quality of comb, eyes, wattles, ear lobes, beak, shanks, and feet. In addition, have good even color as described below.

BUFF COLOR AND HOW PRODUCED.

The Standard calls for one even shade of a true golden buff throughout. This is a most simple proposition that tells us in the plainest possible language that all buff fowls must be a true buff of golden hue;

not lemon buff, nor reddish buff; neither shall it be reddish brown nor snuff brown, but true and simple "golden buff" which approaches a true-colored chamois skin or one of our American (yellow) gold coins.

With buff fowls, more than those of any other color, the greatest attention must be paid to the color of the male. It is almost a hopeless task to try to produce good true-colored buff chicks from poorly or thin-colored males. The color of the male that is to be used for a breeding fowl should be very true and even—neither thin nor ticked. The color should be filled in very closely and dense, so as to make a strong, solid, true surface color that should be well sustained by undercolor to the skin, a shade or two lighter than surface color, but just as true.

It is erroneous to give undue credit for color qualities to the thin-colored specimens which are so weak in color as to look like a faded-out lemon color, and so thin as to allow the white undercolor (which is usual in such specimens) to show through. Such is not buff color. It has no more right to be called true Standard buff than has the red or snuff-brown shades.

After selecting a true-colored male that has the same even shade of buff all over—allowing for the glossy finish of neck and upper portions of body, including wings, which must be of the same even shade—mate him with the very truest colored females that it is possible to obtain. Always follow this rule if possible: Have the females of the true golden hue of buff as called for in the Standard, while the color of the male's breast plumage should be one or two shades deeper in color than the breast of the females.

Never mate deep red-colored specimens with paler lemon-colored ones. This will bring mixed or mossy surface color. The way to establish good, lasting buff color of the proper shade is to mate good, true buff colors together year after year till this color is thoroughly established in the blood, when it can be depended upon to reproduce itself.

The most constant defects in the buff color are the red that comes on the wing bow, the black that comes on the tail and wing, and the white that comes in the tail, wings, and undercolor. Some one of these is always present. A surplus of black seems to drive the others out. Years of experience have taught those who have bred buff fowls that it is a good plan to confine the black to the tail feathers and to hold just a little of it hidden away in the main tail plumage. This can be done, and it helps to fortify against the white. All specimens having the red wing bows should be discarded and used simply as market poultry.

FAULTS TO AVOID.

By all means keep your Plymouth Rocks up in size. Have them look their character. A small-looking specimen which is so fat as to pass muster under weight demands is simply a heavyweight small bird. Breed them to good size. Have them look to be full-sized Plymouth Rocks. It is the good, reasonable size that is needed—not overfat, so as to weigh in at Standard weights. Poor combs are entirely too prevalent. Pay more attention to all head portions, for they count largely for or against the specimen. All fowls should have good, bright, rich-colored eyes. Nothing detracts more from their beauty than poor shape or poor color of eyes. Stamp out the tendency to feathers on shanks or between the toes. Destroy these by sending all that show the slightest tendency to this defect to market as poultry.

The Rhode Island cross still shows its presence by marking some of the hackle feathers with black. Watch for this continually and get rid of it. Keep clear of all unevenness in color and do not allow the color to run thin and light in shade; at the same time avoid the deep dark shades that properly belong to the Rhode Island Reds. Select the true-shaped, true-colored specimens and hold to them and breed for better results, thus building true and well as the stock advances closer and closer to the line of perfection.

THE PEA-COMBED VARIETY.

One of the results of the many additions of new blood used for improving the Barred Plymouth Rock is a barred fowl with the Pea, or Brahma, comb. Such specimens came from true Plymouth Rock matings, and were fostered by several who believed the style of comb to be of advantage. As to their origin, the words of Mr. H. S. Babcock, who, more than any other person, should have the credit of their origin, are quoted. He writes:

> In searching for its origin the writer has received hundreds of letters showing that in various flocks, at sundry times and in divers places, Pea-Combed chickens have appeared, the parents being single-combed thoroughbred Plymouth Rocks. These fowls were so kept that a cross was impossible, in some cases being the only variety upon the place or in the immediate vicinity. The testimony was simply overwhelming in favor of the assertion that the Pea-Combed birds were just as pure in blood as the single-combed ones, and hence they were regarded as a "sport" of the single-combed Plymouth Rocks. A "sport" they have been called, and perhaps justly, though there appears a possibility of considering them a reversion, for it appears from considerable testimony that the single-combed Barred Plymouth Rocks had in their veins a decidedly mixed blood. For example, Mr. I. K. Felch declared in an article written about the time the Pea-Combed Barred Plymouth Rock was admitted to the Standard that a certain breeder of single-combed Barred Plymouth Rocks, acting upon his advice, had bred into his strain the blood of the Light Brahma, and that when the Light Brahma blood had been reduced to one-eighth, the resulting birds were winners. Again, a prominent breeder of Barred Plymouth Rocks told the writer that he had personally crossed into the original Essex strain a Black-red Pit Game, in order to give more vivacity to the fowls, and then had bred out the strictly Game characteristics. It was also learned that another prominent early strain had in its composition the blood of the Dark Brahma, and it is well known that the Black Java used in the making of the original Plymouth Rocks was an Asiatic fowl,

and all Asiatic fowls have a tendency to produce pea combs. Inasmuch as the Brahmas, Light and Dark, are pea-combed fowls, and as Pit Games produce all manner of combs—single, rose, nub, strawberry, and pea—and as all Asiatics have a tendency toward the production of the pea comb, it is possible that the comb upon the Plymouth Rock is due, not to sporting, which means the production of an entirely new character, one not possessed by any ancestor, but to reversion, in this instance affecting the comb only of the fowls. But to one or the other cause (either to sporting or reversion) the pea comb of the Plymouth Rock must be referred, for no immediate cross for its production was ever made. The Pea-Combed Plymouth Rock is as pure in blood as its single-combed ancestor; it is a Plymouth Rock and nothing else.

In breeding it presents exactly the same problem that the single-combed varieties present—careful mating for color and the preservation of the true Plymouth Rock type. In the barred birds the color problem is a difficult one, but not beyond the skill of a good breeder. In this variety the color demand was not forced by competition to the same high limit. For this reason good show specimens were produced from the single-mating system. If still popular at this time, it would be necessary to use the other system to keep to the present demand.

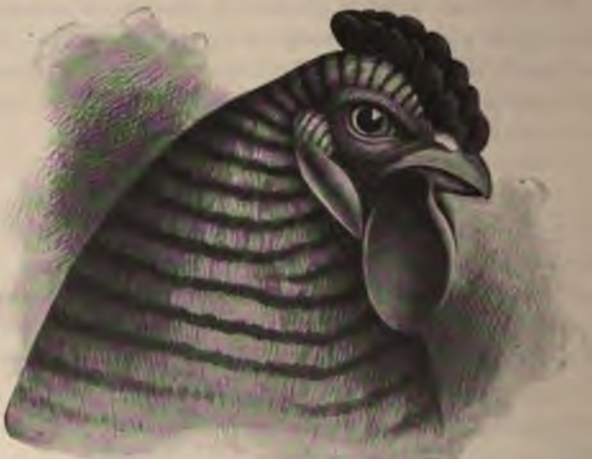


FIG. 219.—Head of Pea-Comb Barred Plymouth Rock male.

This variety never became popular as a fancy fowl, but was quite extensively kept for eggs and dressed-poultry purposes, until finally it was admitted that they were far better calculated for utility than for exhibition. This condition caused them to be dropped from the list of Standard fowls, and at the present time they are seldom seen outside the confines of poultry farms, where they are much valued for their continual egg yield and quick growth for broilers and market poultry.

BREEDS ALLIED TO THE PLYMOUTH ROCKS.

THE JERSEY BLUE.

Jersey Blues are mentioned as among the very earliest productions of American fowls. They were named after the State from which they originated, and became popular on account of their prolific egg yield. Early records tell us that they are the result of a cross between the Great Malay and some one of our other breeds (name unknown), and that the product was a rather long-legged fowl, neither valued as an egg producer nor as a good market fowl. No doubt this original cross from the Malay had the long legs and inferior egg capacity, both of which belong to the Malay family. Why such a cross should be inferior as table poultry can be accounted for only on the ground of poor care or perhaps a Spanish cross.

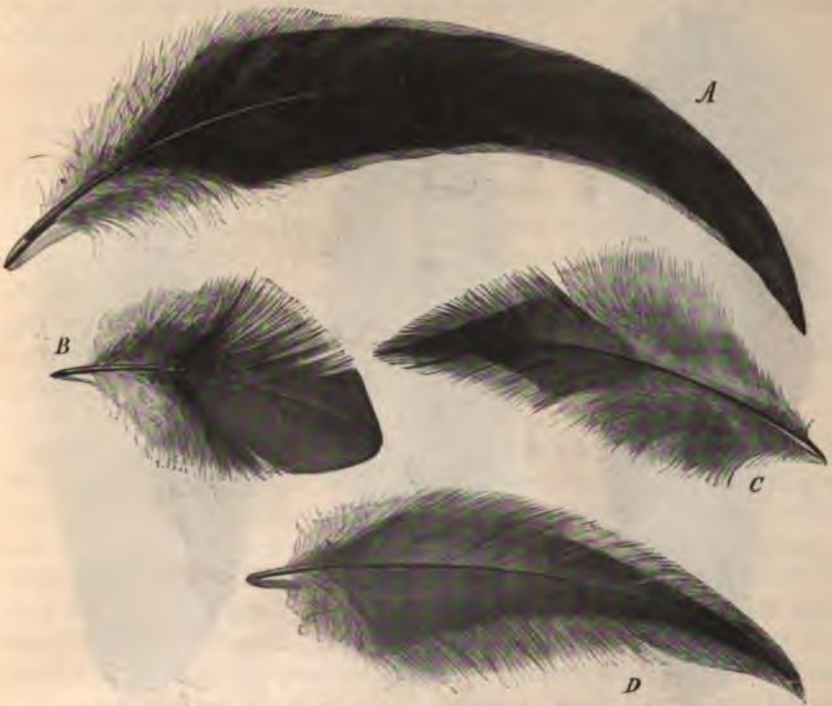


FIG. 220.—Feathers of Jersey Blue male. *A*, tail; *B*, breast; *C*, hackle; *D*, saddle.

The Great Malay of early day did not have the beautiful black-red colors of the present, nor were they the equal in many ways of our present type. As described in their advent, the Jersey Blues were large-sized long-legged fowls, of a bluish cast in plumage, weighing, when full grown, from 12 to 16 pounds per pair. All these facts point to a Malay crossed with either Black Spanish or Java.

Blue fowls, from all time, have come as the result of many crosses, Dark Brahmas crossed with Black Spanish, Minorca crosses, and pure white and pure black fowls, all have produced fowls having blue color in plumage. The entire make-up of the Jersey Blue is similar to that of the Andalusian, which is of Spanish origin, and no doubt the result of crossing a Black and White Spanish fowl, or perhaps two black fowls of different breeds, as it is a well-established fact that either cross may produce a blue specimen.

The present form and color of the Jersey Blue would rather incline one to believe that they are the result of an Asiatic-Java cross. The absence of the white ear lobe shuts out the probability of a Spanish cross, while their large, heavy bodies and underformation resemble the Asiatic family. They have dark eyes, single combs, red ear lobes, and smooth legs. The color of body plumage of the male is slaty blue, each feather being laced about the edge with a darker color; top plumage, including neck, back, saddle, and wings, a metallic blue-black; main tail feathers should be blue or bluish black; beak, legs, and toes of both male and female dark or slate color.

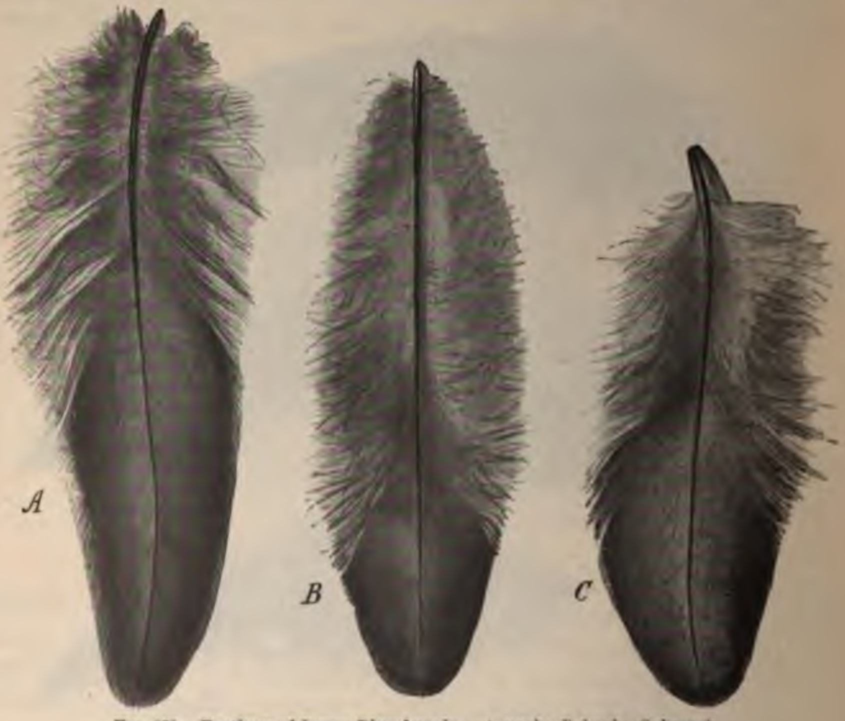


FIG. 221.—Feathers of Jersey Blue female. *A*, neck; *B*, back; *C*, breast.

The female should be slaty blue in color all over, each feather being laced around the edge with a darker shade (color and lacing like that of the Andalusian); the neck somewhat darker than body color; they are of good size, deep and full in breast and body; not long in legs, rather active. They produce an average number of eggs that are of a brown color (indicating that they are not of Spanish origin), medium in size, good, rich flavor. In fact, they are the counterpart of the Andalusian in color and activity, while favoring the Brahma in size and shape of body. Even at this late day they show an inclination occasionally to produce chicks with some feathers on their shanks, suggesting their ancestry.

The Jersey Blue, like the Pea-Combed Plymouth Rock, was formerly allowed a place in our Standard, but so little attention was paid to its improvement that it was thought best to withdraw it from a position among those called Standard fowls and allowed it to occupy the place which it so long filled among the utility fowls.

THE RHODE ISLAND RED.

Few new varieties or breeds of fowls have enjoyed a more quickly gained prominence than has come to the present up-to-date Rhode Island Red. They have been brought into line by breeders known as utility men, who claim for them all requirements that go to make the general-purpose fowl. Yet, withal, we do not think that their ardent admirers claim they will produce any greater number of eggs or better eggs, or that they are any better for market poultry than others of our many American varieties. But if they lack any quality that would go to make them as good as the best, it has been successfully hidden by the claims of superiority.

The Rhode Island Red is a result of continued interchanging of male birds for new blood until its present make-up combines about all the best breeds known to this country. Among these are the Malay Game and the early so-called Shanghai, the Dominique, Brown Leghorn, Brahma, Plymouth Rock, and Wyandotte. From time to time all of these have been added by one breeder or another, and specimens produced by these numerous crosses have been exchanged until all the extensive flocks of egg-producing market poultry throughout the State of Rhode Island are more or less of the same type. The Rhode Island Reds in the Fall River districts of Massachusetts have now the greater reputation.

These numerous crosses have many styles of combs, forms of body, and colors of plumage. The facts are that many flocks of these Rhode Island Reds look like the barnyard fowls found so commonly in the West; perhaps a little larger, but no more regular in color of plumage, shape of body, or form of comb. The demand for solid red males with good single combs, to be used in building up the new Buff Plymouth Rocks, prompted the breeding of them to a definite type and color. Since then more care and attention has been given to breeding in accordance with the Standard rules of the Rhode Island Red Club.

The form of the accepted (or club-adopted) Rhode Island Reds favors the Plymouth Rock. They are rather longer in back and the male has considerably more tail plumage. In size they are rather smaller than the Plymouth Rock; in constitutional vigor very strong, and, like all cross-bred fowls, grow fast, feather quickly, and begin to lay rather early for a large fowl. Their qualities are now fairly well transmitted to their offspring.

The adopted shade of color for the true-bred specimen is red for the male and a modified shade of the same color for the female. They range in color from a reddish orange to the deepest possible shade of dark red for the male, while the females range from a dark buff to a snuff brown. Only a small percentage of those produced can be expected to have the exact color of the parent bird. This uncertainty of color transmission, however, has been improved upon each year, and there can be no possible reason why this bird should not be finally guided into true breeding strains.

They have single combs, like the Plymouth Rock, also rose combs like the Wyandotte, and some are produced with the pea comb, like the Brahma. All these colors of plumage and styles of comb may be found of advantage in building up one or more useful varieties of this new breed.

THE WYANDOTTE.

THE ORIGINAL WYANDOTTE.

The Wyandotte was for years, before it reached its present perfected state, without a name. Its presence was far from attractive, and its average quality was hardly the equal of the common barnyard fowl. So far as the writer remembers, the first Wyandottes were called "Sebright Cochins." The result of investigation was convincing that the Sebright Cochin was the product of the union of a Sebright Bantam and a yellow hen, which might have been a Cochin. Such crosses were termed "mongrels." While there was little attention paid to them prior to 1870, immediately after that year they began to attract some public notice, and mention was made of them in a few of the stock papers of New York State.

A later investigation has shown that several parties in the same section of the country made an effort to produce the Sebright Cochin by crossing the Sebright with the Cochin. This fact is known from letters which passed between those who made the experiment and who interchanged stock, the letters having been presented for publication. The result of the first accidental cross no doubt prompted others to try the experiment. Consequently the original foundation of what are now called Wyandottes came as an accidental product of an unusual union.

THE ACCEPTED THEORY.

The theory of their origin, as accepted by those claiming to be authority, is as follows: A Mr. John P. Ray, of Hemlock, N. Y., originated a rose-comb fowl by a cross of a Sebright Bantam male and a yellow "Chitagong," which he named Sebright Cochins.

Others who became interested (among whom were the Rev. A. S. Baker and Mr. Benson) produced the same kind of fowl. These three persons became so interested with their newly formed fowls that one of them had them illustrated in the agricultural press during 1872. As a result of the publication of such illustrations, these fowls were spread over the country into several States, and were advertised in the columns of poultry journals soon after. Thus, by unguided crosses, was the foundation of this wonderful breed begun. Some carefully planned crosses soon followed, and the able breeder began the labor of molding them into a set type, or form, and of clothing them in a plumage that should be distinctly laced about the edge.

THE WORK OF COMPLETION.

To produce the Wyandotte was no inconsiderable task. To bring the solid buff of the original cross into a white center with black lacing was hardly conceived of at the start, as is proved by the methods employed later. Both Silver-Spangled Hamburgs and Dark Brahmas were crossed upon the Sebright Cochin; Silver-Spangled Hamburgs and Buff Cochins were bred together; and the best of all these crosses merged into what were called Eurekas; also Excelsiors, Ambrights, American Sebrights, Columbias, etc. While all these many names were applied, as seemed to please the fancy of those working on their advancement, the majority of the fanciers had about concluded to call them American Sebrights, and the managers of the American Poultry Association, at their meeting of 1876, were asked to accept them under this name. Fortunately for the breed, their admission was refused. This spurred their admirers to more extended efforts, and so, when the time for their recognition came (1883), they were a much improved breed.

THE NAME SELECTED.

The name Wyandotte was proposed by Mr. Houdlette, at Worcester, Mass., in 1883, and accepted as the future name for the fowl. A general dissatisfaction was shown all over the country at this choice as a name, but those who made the decision should be praised now for their fortunate selection. Time has proven it a most appropriate name, and no one could wish to have it changed.

Since the one original Wyandotte was named, the multiplication of varieties has made distinguishing titles necessary. We now have, as listed in the Standard, the Silver-Laced, Golden-Laced, White, Buff, Black, and Golden-Penciled, or Partridge, varieties. In addition to these we have the following new ones claiming admission: The Silver-Penciled, the Buff-Laced, and the Columbian. In England they have, besides these, a Wyandotte called the Cuckoo Wyandotte. All of these varieties will be mentioned in turn.

EARLY TYPE AND COLOR.

The original type of the Wyandotte was the Asiatic, and at the time of origin the Standard favored the Cochin type more than any other. If it were possible to establish these individualities of form or "breed characteristics" in the minds of all our poultry people, it would result in our having in our poultry as striking a resemblance of form as we have in our sheep, cattle, and horses. As far as the eye can reach it is possible to distinguish a flock of Merino sheep from any other breed; the same is true of cattle and horses. The breed characteristics are no stronger in these animals than they should be in fowls.

When the Wyandottes were admitted as a breed to a position among our Standard-bred fowls they had reached a form and color which were quite distinctive. The males favored the Dark Brahma in form and color, the body color being quite like a well-splashed Dark Brahma. They had smooth legs of a smoky-yellow shade and the rose comb. The females, in form, favored our present Silver-Spangled Hamburg females. In color and markings they were quite crude. Some had grayish white breasts and backs, while others had breasts of white ticked with a darker color and backs mossed with the gray of the Dark Brahma.

A better description would be that they resembled half-sized Dark Brahmas of very inferior color and having Hamburg combs and smooth shanks. In many cases the breast feathers of the male were black, with a white stripe through the center a little larger than the shaft of the feather. The back color of the male was mixed black and brown, while in the female it was mossed quite like the marking of a very inferior Dark Brahma. Such was the original Wyandotte of this now much-valued breed.

ITS RISE AND FALL.

There was an increasing demand for Wyandottes throughout the United States. Anything that resembled their description was sent forth to fill the demand, and much inferior stock was spread about under the name of Wyandotte. The result of such distribution was of temporary injury to the advancement of the breed. Then came the good results obtained by the skillful handling by expert breeders, and the several varieties of Wyandottes were placed in their present well-deserved position.

Soon after the original Wyandotte there came the Golden strain, the advent of which made it necessary to select a distinguishing name for the other; thus we have for the two varieties the names Silver-Laced Wyandottes and Golden-Laced Wyandottes.

Conditions of form and color have changed from time to time. In the Silvers we had the very dark, heavy marking which almost destroyed the topcolor of the males and reduced the white center in the plumage of the female (also on the breast of the male) to almost a stripe or small spot. But in the Goldens a continued effort was made to preserve clear topcolor in the males and the open center of plumage in both male and female. At the present the open center, edged about like the plumage of a well-marked Sebright Bantam, is desirable. Some beautiful specimens of this type have been produced.

THE MODERN WYANDOTTE.

All Wyandottes, no matter what color they may be, must have the same true Wyandotte shape. The demands of the Standard are positive on this point, and this rule should be enforced to the fullest extent. Every breed should be compelled to conform absolutely to the rule that "shape makes the breed, while color designates the variety." Color simply fills the minor position of being a variety emblem, while true shape settles beyond cavil the breed to which a specimen belongs. Therefore, in following the descriptions of the several varieties of the Wyandotte, the one true form must not be lost sight of. The American family or breeds of fowls are divided into three distinct types—the long, or extended, type belong to the Java, the medium formation, to the Plymouth Rock, and the close, compact form to the Wyandotte. All these are shape distinctions, which, if followed to the letter of the rule in each, would result in far more beautiful fowls in all varieties than can be while one variety encroaches upon the special characteristics of the other.

STANDARD FORM.

The head of the Wyandotte, as viewed from the side, should be rather round; broad across the skull, like the Brahma head, but not full or prominent over the eyes. It should round off in the rear to the juncture with the neck, and should have a low-set rose comb (the comb of the female should be much smaller than that of the male) oval on top, from front to rear—often spoken of as a "rocker comb." The surface of the comb must be perfect—nice even points all over. Deep corrugations or irregularities are undesirable. The spike at the end of the comb must be quite distinct, but not so long as in the Hamburg. It should turn downward at the end, or point. In fact, the whole comb from front to rear should conform to the shape of the head. Large or oversized combs must be avoided.

The neck should be short and gracefully arched—that of the female rather shorter than that of the male. The hackle of the male should be long, flowing, and quite abundant, giving the very full appearance at shoulders. If the neck inclines slightly forward it adds to the finish of both head and neck. A long, slim neck, head, or back detracts very much from the good appearance of a specimen.

The description of back, breast, body, and fluff will be here combined, instead of considering each separately. The whole contour of the Wyandotte is short and compact, with a tendency to cushion and fluff. The back of both male and female must be short, broad, and flat at the shoulders; the saddle of the male broad, full, and prominent, or, as worded in the Standard, "broad, full, and rising, with a concave sweep to the tail," thus forming a back quite similar to the back of the Brahma, while the same section of the female should be slightly cushioned. The difference, as here set forth, between the Plymouth Rock and the Wyandotte should be noted. The male of the former must have a back with a slight concave sweep to the tail, while the latter must have the full concave sweep. The female Plymouth Rock has the slight concave sweep, while the Wyandotte female must be slightly cushioned. These are distinctions that all can readily grasp and may be remembered as a guide to proper form. In addition to this the Wyandotte has a full-feathered, well-rounded fluff, while on the Plymouth Rock only a moderately full fluff is demanded. To further illustrate the tendency to Cochin form, it may be stated that the breast of the Wyandotte, when fully up to Standard demand, is broad, deep, and fully developed in both male and female. The whole description of the complete body demands the close, compact formation that is the distinguishing feature of the breed.

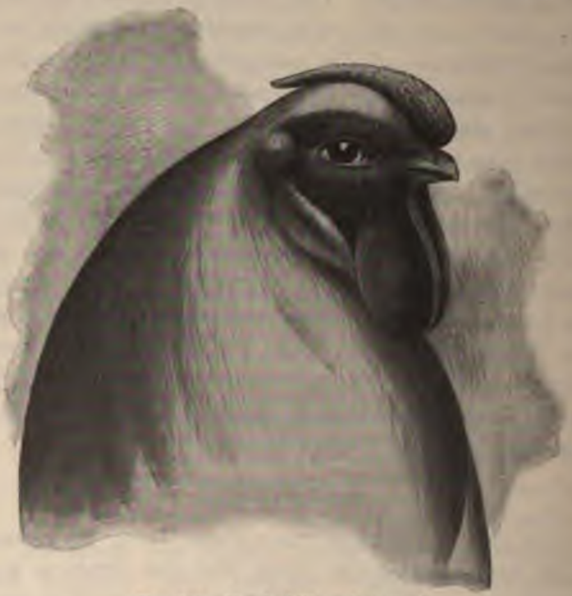
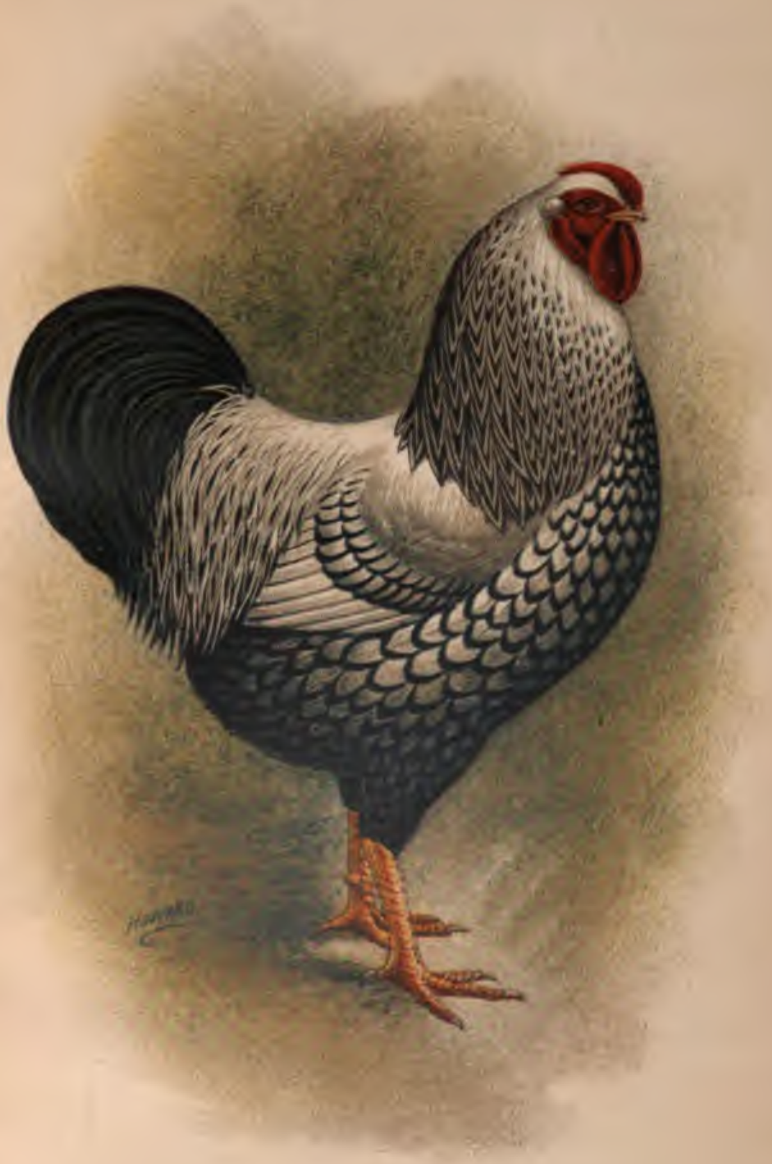
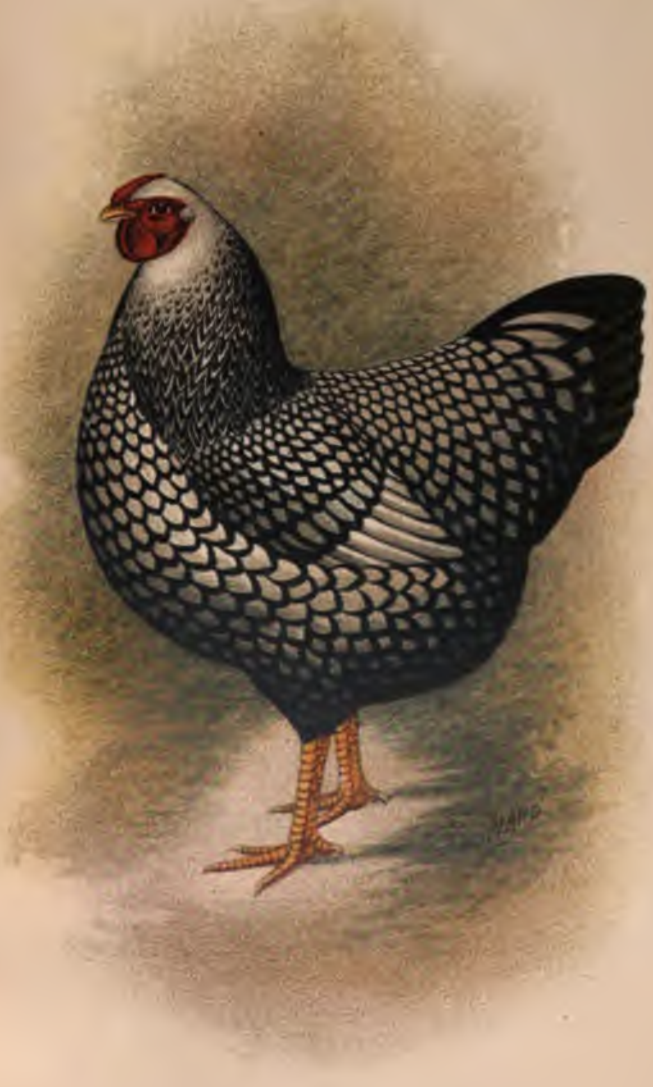


FIG. 222.—Head of Wyandotte male.



SILVER LACED WYANDOTTE MALE.



SILVER LACED WYANDOTTE FEMALE.

The sections of neck, back, body, thighs, and shanks are all described as being short, while the same sections of the Plymouth Rock are described as being medium in length; or, in other words, all these sections must be shorter and more compact in the Wyandotte than in the Plymouth Rock. No one should be misled by these descriptions, but unfortunately the entries in these classes at our exhibitions go to prove that many who claim fully to understand these breeds do not conform to the demands in their selection of specimens for exhibition, and it is too often that we see several forms among specimens which are shown by the same exhibitor.

The tail of the Wyandotte is quite like the tail of the Brahma in form. The main tail feathers should be well spread at base, carried so as to complete the proper formation of back, and not cause breaks or angles. The thigh should be short, stout, well spread, and completely covered with soft plumage; shanks rather short and stout and set well apart, and should be perfectly smooth and free from all appearance of down or feathers. Any tendency to a narrowness between the legs or shanks is an ugly deformity which should be discouraged.

THE UTILITY QUALITIES OF THE WYANDOTTE.

It is claimed that the unusual combination of so many breeds in the make-up of the Wyandotte causes it to produce eggs of uncertain shape and size. If this contention is true, why is not the same true with all crossbred fowls (or made breeds)? Whether this is a fact or not only careful observation will determine. It is a well-established fact that the egg production of fowls can be improved in both number and size if attention is given to the selection of breeding hens. Only those that lay the greater number of the larger size eggs should be selected.

If the greatest attention is paid to inbreeding for form and color, the number and size of eggs produced by each hen will grow gradually fewer and smaller, while, if the whole purpose is toward more and larger eggs, that result will be obtained, and form and color will gradually decline. The Wyandotte having been for years the favorite as an exhibition fowl, it may be possible that some of the most extreme line-bred strains have suffered in number and size of eggs, but this fact has no bearing upon the average utility flocks that are kept for producing table eggs.

All records place the Wyandotte about the equal of the Plymouth Rock in egg qualities, although the Plymouth Rock is credited with an average of somewhat larger eggs, perhaps justly so; but eggs are sold by the dozen, and an ounce or two in a dozen counts for little. The value is in the number produced. At the same time, the larger egg is more attractive, and it is well to give attention to increasing the size.

No fowl can surpass the Wyandotte for market poultry. At any time of its existence, from the small broiler to the roasting fowl, it is always plump and attractive. The close, compact body, the plump breast, and rich color of meat and skin give it many advantages over others. It looks better than the long, lanky type of fowls, even when in inferior condition.

THE SILVER-LACED WYANDOTTE.

The color and markings of the Silver Wyandotte, when in perfection, are most attractive, the many difficulties encountered in their production in anything like Standard color demands have withheld them from public favor. As the male and female differ so widely in color and markings, a full description of each is given. The head plumage of male should be silvery white with a black stripe in the feathers. The neck plumage should be silvery white with a clear black stripe down the middle of each feather, tapering to a fine point, which ends near the extremity of the feather. This black stripe must be completely surrounded with white, entirely clear from any discoloration. The shaft of the feathers may be white. The back and wing bows—in fact, the whole topcolor—must be clear silvery white, free from all foreign color. The saddle feathers must be striped like the neck or hackle plumage, and, in addition to this, they should have in the widest portion of the feather an extended diamond-shaped center of white.

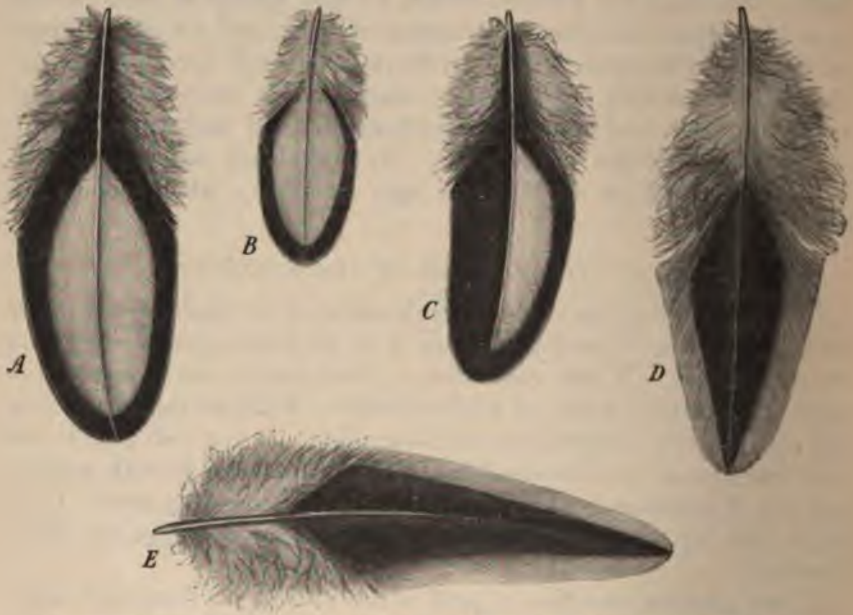


FIG. 223.—Feathers of Silver-Laced Wyandotte. *A*, wing feather, female; *B*, breast feather; *C*, wing covert; *D*, hackle, female; *E*, hackle, male.

The whole topcolor, including neck, must be of silvery white, entirely free from any foreign color. The presence of a tingeing of black or brown on the edging of the feathers casts an unattractive dark appearance over the back; in fact, this is one of the most prevalent color imperfections.

The breast plumage and web of feather is described as follows in the Standard: "Web of feather black with a large white center that tapers to a point." An effort is being made, however, for a large, full white center, simply edged about with black, like the plumage of the Sebright Bantam, the white to be as clear as possible and the black to be as lustrous as can be produced. This style of marking should extend, so far as it can be obtained, under the body and along the thighs. The remainder of the body plumage should be black, with a narrow center of white; fluff, dark slate, powdered with gray; the entire undercolor dark slate. Primaries should be black, lower portion of feather edged with white; secondaries black, lower half of feathers white; wing coverts, upper web black, lower web white edged with black, widening at the tip, forming the double bar across the wing. Tail glossy black; the lesser coverts black, edged with white. The combination of colors of wing gives the beautiful wing bow, the double bar of laced feathers across the wing, and the partially laced bay which is hid away under the saddle plumage.

This gives in the male the topcolor of the Dark Brahma, including the well-furnished, rich glossy, black tail. The beauty of color depends largely upon the purity of the shade. When disfigured with black or brown shading, the beauty is destroyed. The presence of perfect wing bars and bay gives a finish that adds greatly to appearance. When the true topcolor is well backed up by good breast and body, it completes the true-colored Silver-Laced Wyandotte.

The female has the appearance of having the same style of marking throughout, while there is, in fact, considerable variation, as described below. Our Standard specifies that she must have the clear, silvery gray color for head; neck plumage, silvery white, with a black stripe tapering to a point. The white must entirely surround the black and be free from any dark shading; shaft of feather, white; color of back plumage, black, with a medium-size white center, the white to be free from any dark shading, the black a rich, lustrous color; web of feathers of the breast, white, laced about with black. The white center should be large and pure in color; the black lacing quite even, and to run under the body and gradually grade into solid black, with a narrow stripe of white; fluff, dark slate, powdered with gray; undercolor throughout, dark slate.

Wing primaries black, lower outer web edged with white; secondaries black, with lower or outer half of lower web white; web of wing and shoulder coverts white, heavily laced with black, the black lacing growing wider over the wing bow; tail black; greater coverts black; lesser coverts black with narrow white centers; thighs black, or black powdered with gray.

Beak of both male and female dark horn color, shading to yellow at the point; shanks and toes bright yellow; eyes bright bay; ear lobes bright red, free from all discoloration.

While the above describes the color and markings of the female, the present tendency is toward the very open center and the narrow black lacing, like the plumage of the Sebright. A few specimens of this character are seen with almost pure white, with bright, lustrous black lacing. The real beauty of the female depends upon the clearness of color, being entirely free from all tendency to dark shading in the white or white edging on the black.

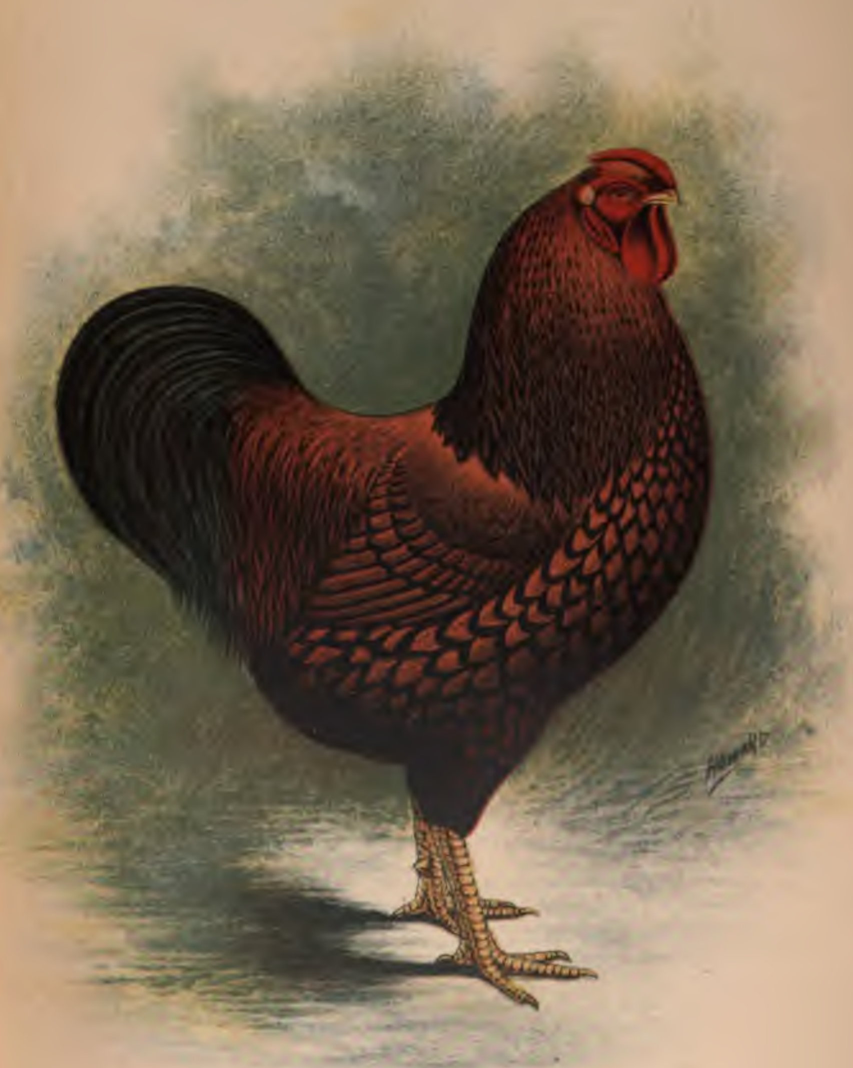
MATINGS TO PRODUCE SILVER-LACED WYANDOTTES.

The first requisite of good results from any mating is perfection of form and breed characteristics in both male and female. It is almost an absolute certainty that poor specimens will produce of their kind; the most advanced quality only must be used as breeding stock. Great care must be exercised in the selection of specimens that are very strong in comb qualities, shape of head, and the parts belonging to it. The specimens selected must have bright, well-formed eyes of the true bay color. No two features count more in favor of or against a Wyandotte than comb and eyes. The very best quality in these adds much to their good appearance.

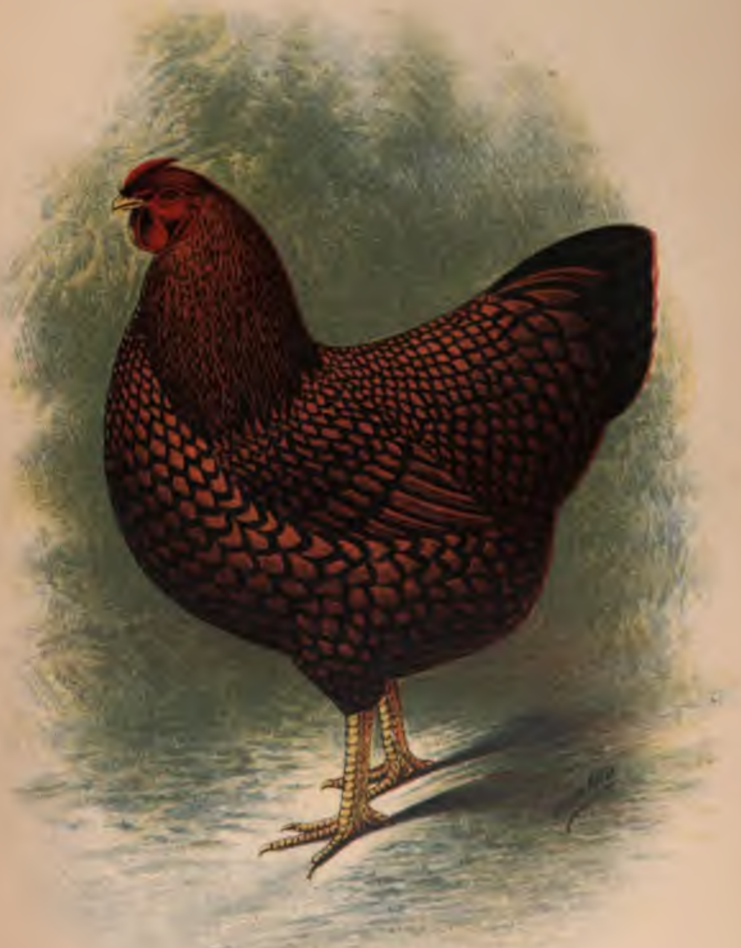
Next in importance to good form is size, which should be encouraged so far as is allowable within the limit of maintaining true form. Oversize detracts from the Wyandotte shape; undersize counts against its value. For this reason it is best to have as much size as can be maintained with the best possible breed characteristics. So far as possible, good, large-sized females should be used; it must be borne in mind that size comes largely from the female, while the male has the greater influence for color and head properties. For this reason, males with poor combs and bad color, as well as all small or undersized females, should be discarded from breeding stock.

The topcolor of the male should be very clear and true and as pure and silvery white as it is possible to obtain. The striping of hackle and saddle should be clear and free from dark edging; breast plumage darker than is demanded in the offspring; the white center not to cover more than one-half the feather, and the edging rich, glossy black; tail of the richest metallic black, with no trace of mossing in any part of plumage. If good open lacing is hoped for in the pullets, the male must have the white diamond center in saddle plumage and no trace of bad color on back.

The females should have most perfect open lacing. If they are so



GOLDEN LACED WYANDOTTE MALE.



GOLDEN LACED WYANDOTTE FEMALE.

finely laced as to have simply a narrow black band around each feather, so much the better, providing the centers are all true in color and free from any mossing whatever. The edging should be a rich, glossy black with the beetle-green sheen. Such distinct markings are necessary to the production of the Sebright lacing. Matings of this kind are apt to produce many specimens which will be too light for any use other than table poultry. At the same time some beautiful specimens will result as part of their offspring.

The above mating should produce by far the best females, but the markings are rather too light for the production of males. The male described above when mated to females whose plumage is about equally divided in color—not more than one-half white, but pure, true, and rich in color—will produce far better males than females. Both styles of female can be mated with the same male and assure the production of males and females of good quality from the one pen. Although some continue the use of females that have so little white centering in plumage as to look like a spot or stripe on the feather, the use of these should be considered a waste of time. Not one open-laced specimen of good quality can be produced from this kind. It is well to bear in mind the necessity of having more black lacing on the breast plumage of male than female; but to secure good results, about an equal division of color is best.

These matings are all on the side of the lighter shade and narrow lacing, and will produce quite a percentage of young that are too light for practical purposes—a result that seldom comes, because the majority of all matings are so very dark as to produce the larger percentage of young too dark for show purposes. It is quite easy to mate the darker ones together and have them as dark in color as could be wished. This gives one the choice of mating according to fancy, with full assurance of desirable results from the light, medium, or dark matings.

THE GOLDEN-LACED WYANDOTTE.

The Golden Wyandotte was the second variety of this breed that was brought before the public. The most successful attempt at its production was made by Joseph McKeen, of Omro, Wis., who first produced a fowl which he called "Winnebagoes," that being the name of his farm. These Winnebagoes were the result of crossing Rose-Combed Brown Leghorns, Pea-Combed Partridge Cochins, and some buff females, these latter the result of a Golden Sebright-Buff Cochin cross. The best males produced from the combination of these several breeds were mated with some American Sebright females. Thus was produced the foundation of one of the most valuable strains—possibly the most valuable.

Some breeders, aiming for the same results, united the blood of the Golden Spangled Hamburg and the Partridge Cochin and crossed this product with the American Sebright. None of these crosses were as successful as those made by Mr. McKeen; but, as with the Silver-Laced Wyandotte, the careful selection of the best and their proper union gave the start of what has proved to be a valuable addition to the Wyandotte family, which is now so highly respected the world over.

Here again we have the double Asiatic cross of the Partridge and Buff Cochin with the Sebright Bantam. In this instance the Golden Sebright was crossed with the Buff Cochin and the product united with the rich black-red colors of the Partridge Cochin and Brown Leghorn. The rich-colored males from this combination of blood were bred to selected females of the American Sebright breed (now Silver-Laced Wyandottes). Almost the same identical combination of blood produced the Silver. It originated from the silvery white of the Dark Brahma and Silver Sebright, as mentioned before, while the top cross for the Golden came from the Golden Sebright and the black-red colors of the Brown Leghorn-Partridge Cochin union. Great patience and care were necessary for the completion of this variety, not so much to insure good Wyandotte form (this came as naturally to them as to the Silvers), but to establish the true golden-bay color to conform to the white of the Silver, and at the same time gain the deep rich topcolor of the Partridge Cochin for the male.

THE COLOR OF THE GOLDEN.

The influence of the buff color of the females employed for the top cross, also the white color of the American Sebright females, was a very pale shade of golden bay for the males and yellow centers for the females. This color has been improved to the extent that we now have a deep golden bay for the topcolor of males and yellow bay for the females and under portion of males. The tendency is toward a deeper and more brilliant color in both, and for a topcolor on males of almost as rich colors as that of the Partridge Cochin. Gradually these colors have been deepened until the present rich shades of the finer specimens are quite in contrast with the old-time yellow shades.

Our present Standard specifies that the color of the Golden male and female shall be the same as that of the Silver Wyandottes, except that "golden bay" should be substituted for "white." This substitution of golden bay for white falls short of describing the rich topcolor of the Golden-Laced male, which now rivals the Brown Leghorn in brilliancy of color and richness of striping. This bright rich color is not in accord with the Standard, which calls for a deep golden bay for topcolor. A golden bay is not a bright, nor is it a deep, red; it is simply a golden-tinted bay. Everyone is familiar with the bay color as applied to a horse, which is a red bay; but the color demanded for the Golden-Laced Wyandotte is golden bay; or, as described by some, a mixture of pure gold and red.

The striping of hackle and saddle plumage must be the same in the Golden as in the Silver—the same diamond center in saddle and the same open lacing on both male and female. All conditions of marking, lacing, and striping must be the same in both. It adds much to the beauty of the Goldens if the Sebright lacing is obtained. Many specimens are seen at the present time which have the very open center of rich golden bay edged about with metallic black that glistens, forming a most beautiful combination of colors.

The gradual changes from the narrow stripe, or center, to the open lacing have modified the methods of mating to such an extent that some adopt double matings to produce show specimens. It is claimed that, to insure good females, it is undesirable to use males having the open lacing on the breast. Such matings yield females having too much white. To secure good females, it is best to employ males having at least one-half black on the breast plumage and females having good open lacing. In some cases those very gay or open-laced specimens will produce solid white chicks.

For all ordinary purposes it is best to mate for medium centers, using females that have the larger portion of their plumage very open laced and males having rather dark breast plumage and good clear topcolor. It is much better to confine yards to one pair, trio, or pen rather than try to produce nicely marked stock from a male with bad topcolor. Depend upon this fact, that if the male has bad topcolor, the same will be found on his chicks as they grow up. Too many males having black edging on back and saddle plumage (a defect that has been bred into them for many years) are used. This black edging is not nearly so prevalent in the Golden as in the Silver Wyandotte. More attention has been paid to the former, and this has driven out the mossing in back plumage of females and given to the Golden a more even surface color. As a whole, the Goldens are much better in surface color than the Silvers. To succeed in improving the Silvers, good silvery males having clear silvery white topcolor, free from black edging, and saddle plumage having white centers must be employed; otherwise too many females will have mossing on the back.

TO PRODUCE THE GOLDEN COLOR.

In selecting a Golden-Laced male for a producer, choose one having the golden-bay color—not a reddish bay nor a chestnut color, but a golden shade of bay. Keep clear of light or yellow shading on breast and dark shadings on back or wings. By all means have good, clear hackle plumage, nicely striped with black and free from smut. Many are too deep a bay or red; some are as rich in color as a Partridge Cochin. This is not as the Standard reads. It calls for a golden bay; not even a rich golden bay is demanded.

The same conditions govern the Goldens as govern the Silvers. Very open-laced specimens will produce offspring which grades lighter in color than the parent birds. The medium-colored specimens will produce the medium shades; the very dark specimens will produce the darkest chicks. This makes it possible to mate the Goldens in the same manner as given above for the Silvers with about the same results. In all matings use only those specimens that have the true golden-bay color laced with the rich, glossy black that glistens with a beetle-green sheen.

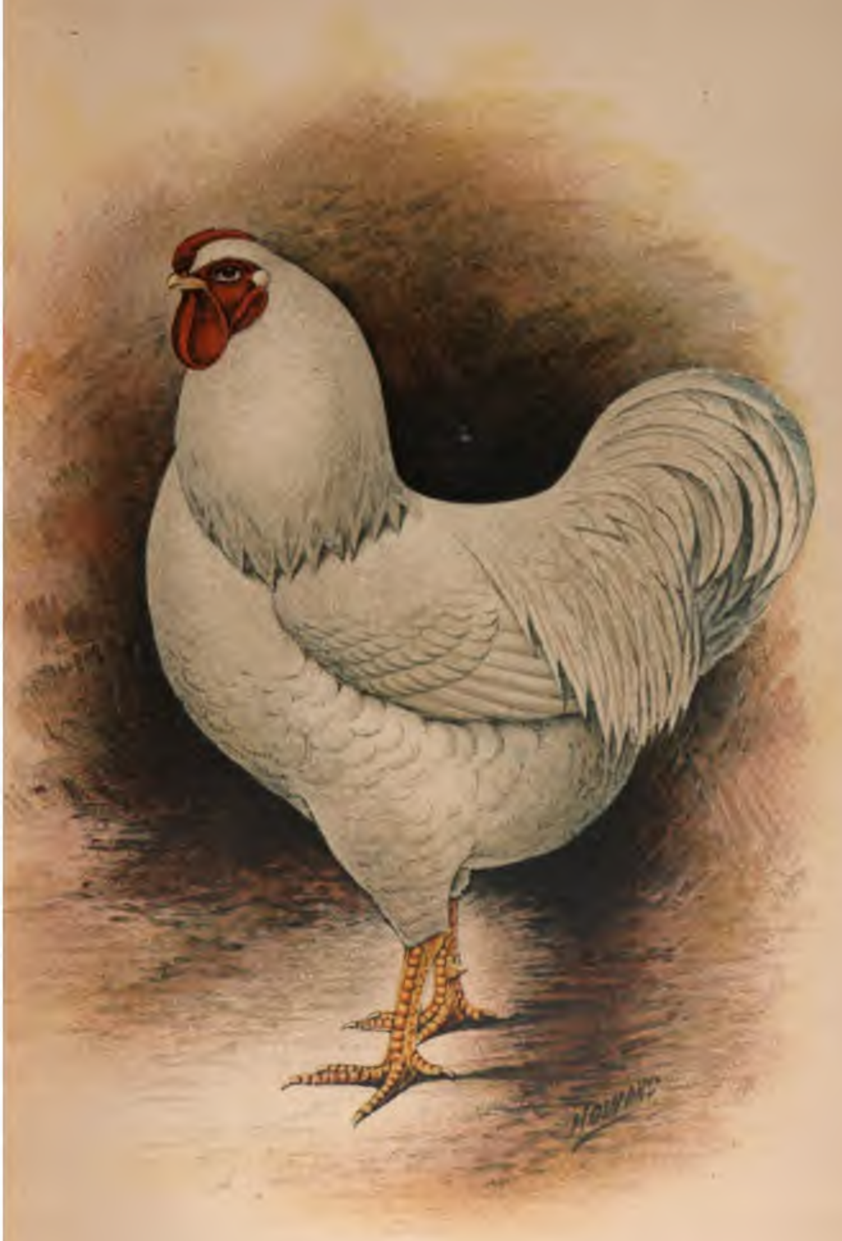
It is claimed that one of the very best plans for mating is to select a perfect male in form and color and place with him females, some of which are light and some dark in color, in order to gain the advantage of both shades in the one mating. Of one result there is the greatest assurance, namely, the loss of the proper color, unless the strictest attention is paid to its maintenance by using only such males as possess the true shade and the rich black lacing. In all matings the breast plumage of the male should be darker and heavier in lacing than the females. This applies to both the Silver and Golden varieties.

A very safe plan of mating is to select both males and females with the medium centers and mate them, year after year, until this line of breeding is established in the strain. Such matings will produce both sexes of fairly good quality and a greater percentage of good salable birds than may be expected from the other more extreme matings. All these matings may be used in both varieties; the more extreme mating to produce the light open-laced Sebright markings, the medium colors for the average quality of exhibition specimens usually seen.

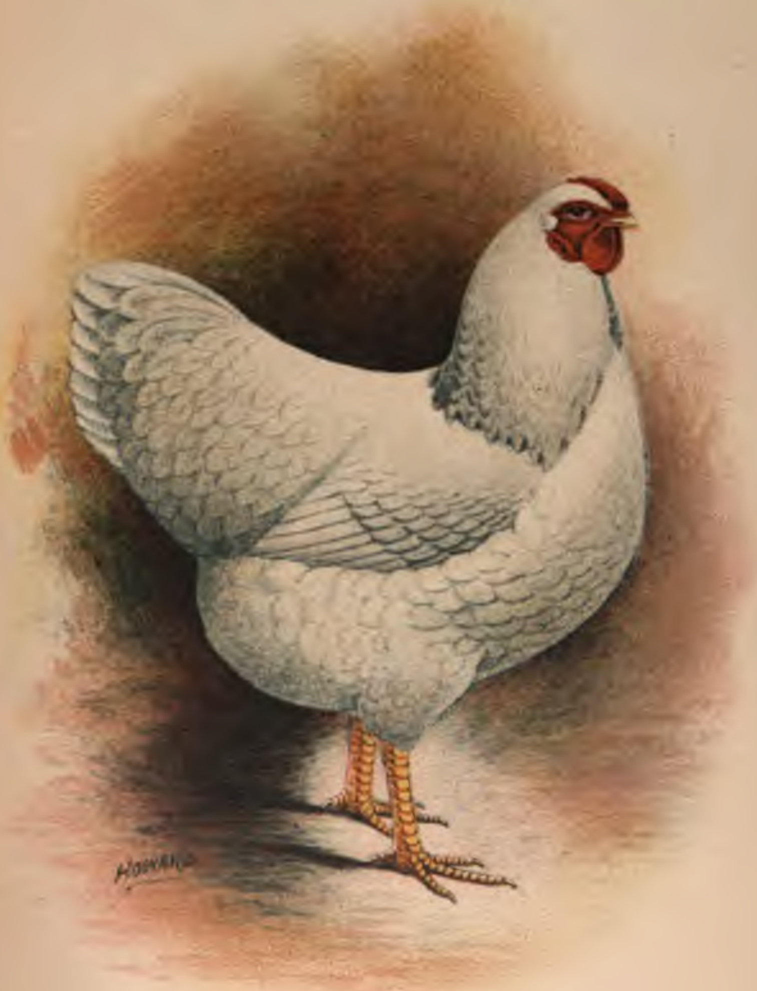
THE WHITE WYANDOTTE.

The white variety of Wyandottes originated as sports from the Silver-Laced. It is claimed that some of them appeared as early as 1872. If this is true, those of that early date had not much of quality in their ancestors. Early writers speak of them as better in Wyandotte shape than the Silvers, and regard them as models for all varieties. Much of this distinction, it is presumed, was the outcome of applause arising from the pleasure of adding a new variety to the list of American fowls.

When it is considered that as late as 1883 the Silver-Laced Wyandottes gained only quality of sufficient amount to establish them as a Standard breed, what must they have been in 1872, at which time it is claimed that the white sports were produced? The statement is not questioned that they did produce both solid black chicks, also solid white ones, for this is known to be the fact. At the same time the quality of these self-colored sports was no better than the parent birds from which they came as sports. The strong-breed characteristics of the whites, when present, is the result of careful mating and the influence of Asiatic alliance.



WHITE WYANDOTTE MALE.



WHITE WYANDOTTE FEMALE.

We are informed that an exhibition Silver-Laced male of merit (from England) mated to some of the very best American-bred females has in the past two seasons produced some beautiful-shaped White Wyandottes. This continued production of white chicks from Silver-Laced Wyandottes has existed from the very incipiency of the breed to the present time. Such a large production of solid white chicks throughout the period of twenty-eight years points to a reversionary, rather than to a sporting, condition. Or, in other words, it leads to the opinion that they "throw back" to white ancestry rather than show a tendency to sport or produce albinos.

THEIR ORIGIN.

The credit of their origin is given to George W. Towle, of Truxton, N. Y., and B. M. Briggs, of Wyandale, N. Y., both of whom did much for their advancement. If our information is correct, it was not until 1885 that the White Wyandotte was brought prominently before the public; and its admission to the Standard, in 1888, was accomplished at the meeting of the American Poultry Association held at Indianapolis in that year. Prior to 1892 there had not been produced any considerable number which attracted attention in quality of shape or color. During the years intervening between 1878 and 1885 white chicks came too often from the Silver-Laced variety. Their breeders considered it as positive proof of impurity in the breeding stock. Efforts were made to shield the fact until it became known that they would be advanced as a true variety of the Wyandotte family; then many willingly acknowledged the presence of the white sports in their yards. Few varieties of fowls in this country have ever been as well managed as these have been. Both utility and exhibition qualities have been fostered equally. The result is greatly in their favor and makes them one of the strongest, if not the strongest, competitors of the Barred Plymouth Rock for public favor.

AN EXHIBITION FOWL.

In the history of American poultry exhibitions there has not been recorded a more popular fowl than the White Wyandotte. It has gained so fast in this direction as to call together the largest classes at our fall and winter shows. Large sums are continually subscribed by those who are interested in their welfare for special awards in these classes, thus creating an unusual interest in them, and rendering them more and more popular. They have met with but one obstacle as they have gone forward, and that is the new Buff variety.

Great improvement has been made in their shape and color. Almost perfection of shape and immaculate plumage must be present with the specimen that now wins the honors. Medium quality has but little chance in the show pen in well-contested classes, and poor condition of feather is almost certain to bring defeat. No fowl is more beautiful or attractive than a pure white one in prime condition of plumage. Feathers of such purity rest most gracefully upon the White Wyandotte.

UTILITY QUALITIES.

The White Wyandotte is without question the model for market poultry. The compact form and full plump breast give the desired broiler as well as the most perfect roaster. The color of the meat and skin is of that attractive yellow so much in demand in our markets. It has the combination of desirable shape and color, and the white plumage removes all chance of prejudice so often advanced against dark pin-feathers, thus giving it three very important advantages for sale as market poultry.

There is but one drawback to contend with in pushing the White Wyandotte for a more advanced position as a utility fowl, namely, its inclination to produce eggs that average undersize when compared with the size of the fowl. In the markets that bring the highest prices for eggs the larger in size are the most valued. The White Wyandottes lay quite as many eggs as are laid by the Plymouth Rocks or by other varieties of Wyandottes, and their eggs are of good color and firm in shell. They are quite as economically kept as any breed, with an inclination to accumulate fat with age, which counts in their favor when sold for market fowls.

THE QUESTION OF SIZE.

There seems to be a rule governing form which confines its greatest perfection within certain sizes. Undersize in the Bantam deprives it of the highest form. As oversize in the Brahma detracts from its grace of contour, this same influence works against an effort to advance the size of the White Wyandotte beyond the limit of the rule governing the individual form. Bad shape has come with these mistaken efforts, and this should be a warning against a continuance. It is well to guide them in size within that limit line which gives assurance of a maintenance of the best breed characteristics, but not to go beyond. Hold to their beautiful form by all means; that is their real attractiveness and value. Do not try to gain size, which can not prove of value as against the loss of form.

We have the greater size in our Asiatic fowls. A large Wyandotte can not excel a larger Brahma as a meat fowl, while as a Wyandotte of proper proportions it may meet with greater favor. The White Wyandotte, as it should be, has as much size as is consistent with its position as a general-utility fowl. The grace of form and exhibition qualities can be maintained within these conditions as to size. Both the Brahma and the White Wyandotte can be improved within the limits of the rule which controls form as against size, and both may be injured in an effort to go beyond these limits.

HOW TO MATE THEM.

To produce White Wyandottes for exhibition, we must look simply for perfection of form and purity of color, with good head points. The male should be a model of Wyandotte shape, clothed in absolutely white plumage that is true and pure in color to the skin, including the quills; head and comb in strict conformity with Standard demands. The female should be superb in all sections in both shape and color. No hope of success can be placed on inferior breeding stock when the aim is to produce winners of the highest character.

The following special points of value may be considered to advantage: Do not use White Wyandotte females that have narrow, contracted main tail feathers to produce winners, although this is permissible with the Plymouth Rock. Have the well-spread tail on all Wyandotte females used for breeding exhibition stock. Such matings are of the very highest character, and, while they are difficult to secure, they are almost certain to give returns that will fully repay for the necessary trouble and expense.

When such quality is not obtainable, the following methods involved in building up a strain should be pursued: Select the very best at hand year after year until some are produced that are equal to the best, and from these hope may be entertained for a reputation in the showroom. In any class where the competition is as keen as in the White Wyandotte specimens are always met in competition from the yards of the most successful producers, thus making it of the utmost importance to select as breeding stock those of the highest merit for breeding winners.

Other features of great importance are purity of color of ear lobes, beak, and shanks, including the feet. White ear lobes and shanks other than yellow are disqualifications not removable. The presence of either is prominent and should be avoided. It is equally important that there should not be the slightest trace of feathers or down upon the shanks or between the toes of any breeding stock. The absolute avoidance of this will alone assure against its future appearance, and it should be guarded against with the greatest care.

WHITE AS A COLOR.

Pure white as a color of plumage in fowls is quite as difficult to maintain as any other color or particolors. A cream or yellow or black tinge must continually be contended against; any one or all of these colors may crop out when least expected. The most perfect white shade is apt to be sprinkled with black, and the yellow undercolor must be fought against unceasingly. The surest means of obliterating these undesirable tinges is by the selection of males that have absolutely white plumage, including undercolor and the quills, or shafts, of the feathers.

Many of the most attractive and vigorous male White Wyandottes show a tendency toward the yellowish tinge in plumage, but their other desirable qualities are inducements to use them as breeding specimens, the result often being disappointing. It is better to discard them than to run the risk of infusing the taint of yellow into the flock. Equal care should be given to the selection of white females.

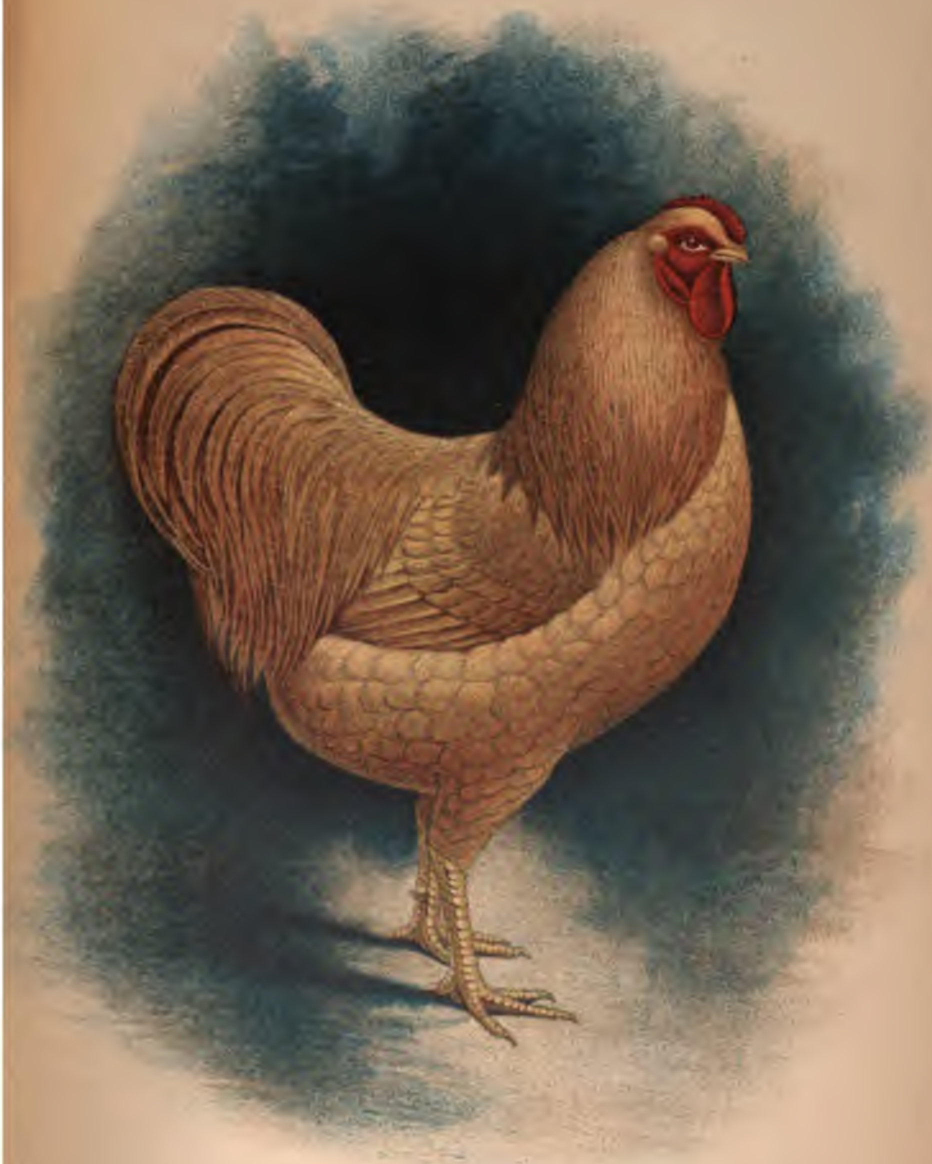
THE BLACK WYANDOTTE.

The Black Wyandotte originated in the yards of F. M. Clements, jr., of Mechanicsburg, Ohio, in 1885. It came as a sport from the Silver Wyandottes. The first Black Wyandottes possessed by him were a few black pullets, which he mated with a male having black body plumage and a silver hackle. From this start he built up a true breeding strain of blacks, which are credited with being the foundation of those we now have. The care bestowed upon them by Mr. Clements brought the Black Wyandotte to a condition of good reproducing power, and they could be depended upon to produce solid black plumage with good dark undercolor, red ear lobes, dark shanks, and correct style and shape of comb.

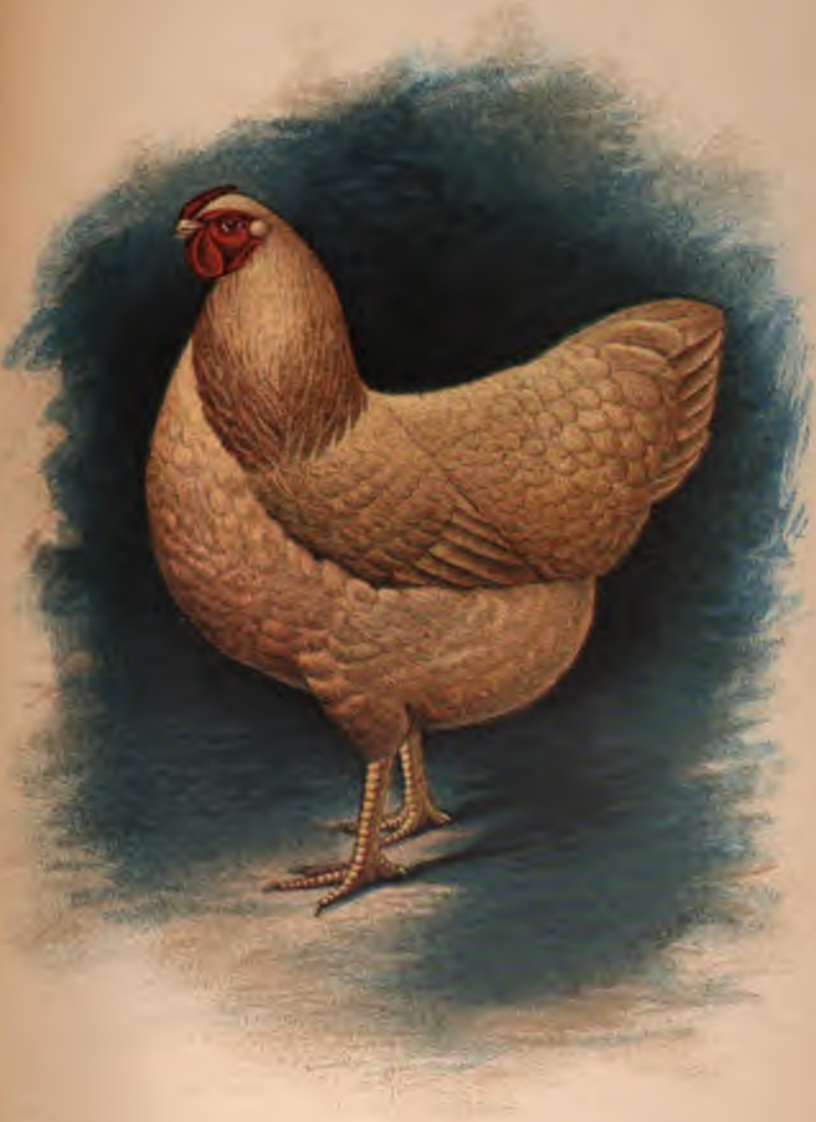
Good size was also present in these early Black Wyandottes, and the color was improved by Mr. Clements into a rich glossy black, giving them a good start in the right direction. Breeders who thought it best to have the same yellow shanks and feet as other Wyandottes did much to injure this variety for several years. It was finally settled that it was impossible to have the yellow shanks and feet with good black surface and undercolor. This information, gained by bitter experience, resulted in establishing the original dark color for beak, shanks, and feet.

It is unnatural for black fowls (or birds of any kind) to have other than dark or black legs and feet. When any other color is present, it is an abnormal condition, brought about by artificial methods, which demands undue care in their reproduction to prevent undesirable colors coming into the plumage. Careful consideration of these facts guided the framing of the Standard description for this new variety, which is: Black shaded with yellow as the color for beak, shanks, and feet, at the same time demanding that the bottom of feet shall be yellow, and making the absence of this yellow a disqualification.

Time has proved the possibility of producing both good shape and color under these Standard requirements. Within the last few years some beautiful-colored specimens of excellent Wyandotte qualities have been shown, some of them fully the equal of any of the other varieties. But American prejudice against black fowls has barred the way of the Black Wyandottes to much-deserved popularity. The same influence has counted against all other black fowls, many of which have qualities



BUFF WYANDOTTE MALE.



BUFF WYANDOTTE FEMALE.

that rival any or all other breeds. Much of this feeling has been removed within the last ten years, and it may be that a better appreciation is in store for all fowls of this color.

MATING FOR COLOR.

The position filled by the Black Wyandotte is quite that of "the fanciers' fowl." While it is fully the equal of the other varieties in utility requirements, it has never been urged with the same vigor for public popularity. It can hardly be expected that it will gain equal prominence with the Whites, handicapped as it is with a less popular color. At the same time persistent effort in its behalf would make it equally popular with the Langshans or Minorcas.

In all matings of Black Wyandottes better shape and breed qualities of all kinds should be present, if possible, than can be usually obtained in other varieties. It is also necessary to have the most perfect shape, else they are of but little value. It would be better not to attempt their production for profit unless most excellent specimens can be had to breed from. The fact that they are a "fancier's fowl" means that all that are not fully equal to Standard requirements are to be relegated as table poultry.

For best results mate the richest colored male with the purest black females that have but little gloss, or sheen, in their plumage. They will produce the better-colored males; while the very rich-colored females, glistening with the metallic sheen, will produce the best-colored pullets if mated to this same rich-colored male. Many of the cockerels from these rich-colored females will have an excess of color, which disqualifies them. Those that have the proper finish, or shade of color, will be rich and glossy in the extreme, but the more somber-colored females must be depended upon for the exhibition males.

Always select good, dark undercolor and dark legs, as they give assurance of an established color in the blood, while the light or willow colored legs and the pale undercolor bespeak the influence of the lighter shade of the ancestors, the influence of which is detrimental. Good, strong black, through and through, including undercolor and quills of feathers, is the best assurance against white in the offspring. All these features of color must be closely watched if we hope to succeed in producing Black Wyandottes of highest quality.

THE BUFF WYANDOTTE.

There has been considerable contention about the question of priority of production of this variety. From all information at hand the indications are in favor of George H. Brackenbury, of Auburn, N. Y., as the pioneer, with Dr. Aldridge and R. G. Buffington, of Fall River, Mass., close seconds. These two distinct lines were produced under different methods. One was formed from Wyandotte-Buff Cochin cross; the other came through the Rhode Island Red-Wyandotte cross. Other strains came from different crosses—all aiming for the same end, but each using a separate rule of procedure.

The New York strain of Buff Wyandottes was produced from the union of Wyandotte males and Buff Cochin females. This strain was largely Cochin in blood and form, in color of wings and tail, and in surface color, and is the best of any of the early productions. The amalgamation of this and the other strains improved them all and gave them the start toward their present perfection of form and color. The Buff Wyandotte is nearer related to the Asiatic family than any of the older Wyandotte varieties, as the latter were crossed again upon the Cochin to gain the desired color. The original Fall River strain (so called) came as the result of an unguided cross of Silver-Laced Wyandottes and Rhode Island Reds. The Rhode Island Red, a cross-bred farm fowl, in union with the Wyandottes, which were placed among the Reds to advance their value as market poultry, gave a product that was molded into the proper form and color for the Buff Wyandotte. The Rhode Island Red was largely descended from the early Asiatics, and thus gave renewed strength to these later blood lines, and adding to rather than detracting from the tendency toward Asiatic form. This strain was badly handicapped with black in tail and wings, an inheritance from both ancestors. The union of these two strains gave strength of character and better color. The original formation of each seemed to blend with the other, offering little resistance to the hand that was guiding them to a more perfect condition.

The third strain came from the union of Buff-Laced females of very little lacing (which came as sports from the Golden-Laced variety) with a male from the Fall River strain. These three lines of breeding have furnished the foundation of this most excellent variety.

While in quest of better color the shape and size have been neglected to a considerable extent. The fact that there are many specimens of good form and color that are oversize is positive proof that size, shape, and color can all be maintained without injury to either characteristic. It seems to be a necessity to breed closely in line to establish and maintain good color and breed characteristics. While this is true, it does not establish the necessity of selecting inferior size and shape as one of the requirements. Shape must be considered at all times as of first importance; size should be of almost equal consideration with color; and never should color stand paramount to both.

SELECTING FOR BREEDING.

The proper selection of Buff Wyandottes to be used for producing exhibition specimens of merit is a difficult task. First of all, the possibility of perpetuating disqualifications—such as white ear lobes, bad combs, and poor-colored shanks and feet—is to be guarded against.

Eyes should be prominently bright and clear and of a good bay color; shanks and feet a good yellow color, very smooth and free from any semblance of either feathers or down; comb and all head points should be almost perfection in form and texture.

It is worse than folly to hope to obtain good Wyandotte shape from ill-formed parents. Discard as breeders all faulty specimens and continue to use only the best, for in this way only can excellence be obtained. Good size and vigor are of the greatest importance. Without these, little prospect of advancement can be had. It is hardly necessary to again mention the fact that all varieties must have the same breed shape. This is doubly true of the solid-colored varieties. The one solid color and the shape are the only necessities for perfection; but the demand for excellence is by far more rigid against solid color than particolored fowls.

Equally as much care must be given to the selection of the females as to the males. Each must have the greatest amount of quality obtainable. Good form, good size, and constitutional vigor are quite as valuable in the female as in the male. It is the female that casts the greater influence over size and form. Good color is an absolute necessity in the male, as he imparts the greater influence over color. All these features should have careful consideration when selecting breeding stock.

TO PRODUCE BUFF COLOR.

It is safe to presume that there is no color of a fowl so hard to produce and maintain as the buff color. There is but one true buff color. Lemon shade is not buff; a red or cinnamon color is not buff; neither is a reddish brown a buff; the true shade is "golden buff." The term used for Standard buff color is "one even shade of rich, golden buff free from shafting or mealy appearance." This is simply a true rich buff of golden hue. Many produce a thin uneven shade of lemon yellow and call it buff, while others favor a deep orange buff or cinnamon color and present it as the true shade for buff. These are not the true golden buff.

The proper shade of buff, many say, is a mixture of yellow, red, and white, or a combination of yellow and pink. This is absolutely true when mixing colors on the palette, but many years of experience have proved that it is far more difficult to control the color of plumage than to properly mix the paints. It is easy to say: Keep out the black or drive out the white; but it appears when least expected. Buff is a made color—it is not a natural color—and there is but one rule for its certain production, and that is the union of the truest color possible to obtain, year after year, until a strain is established that will breed true to color.

A continued system of inbreeding for good, sound plumage color has many drawbacks. Reduction of size and loss of form are the most serious. To obviate this, new blood must be introduced from time to time, the admission of which brings with it more or less disturbance of color lines, causing a continual oscillation between good color and good form. One of the principal assurances of good color is the proper undercolor and color of shafting or quills—all of which should be buff to the skin and of a shade somewhat lighter than surface color. Whatever the shade of buff may be, let it be even and true all over and through and through.

It is not advisable to mate light and dark specimens; the result will be a mealiness in plumage of chicks. The very best selection is of females having the true golden buff, and of males whose breast color is one or two shades darker than the females, all to be very even in color and free from any shade other than the buff. Black and white should be avoided. If white is present, it is quite likely to show in undercolor and on wings of the offspring. Black will show in the wings and tail. Both are equally objectionable.

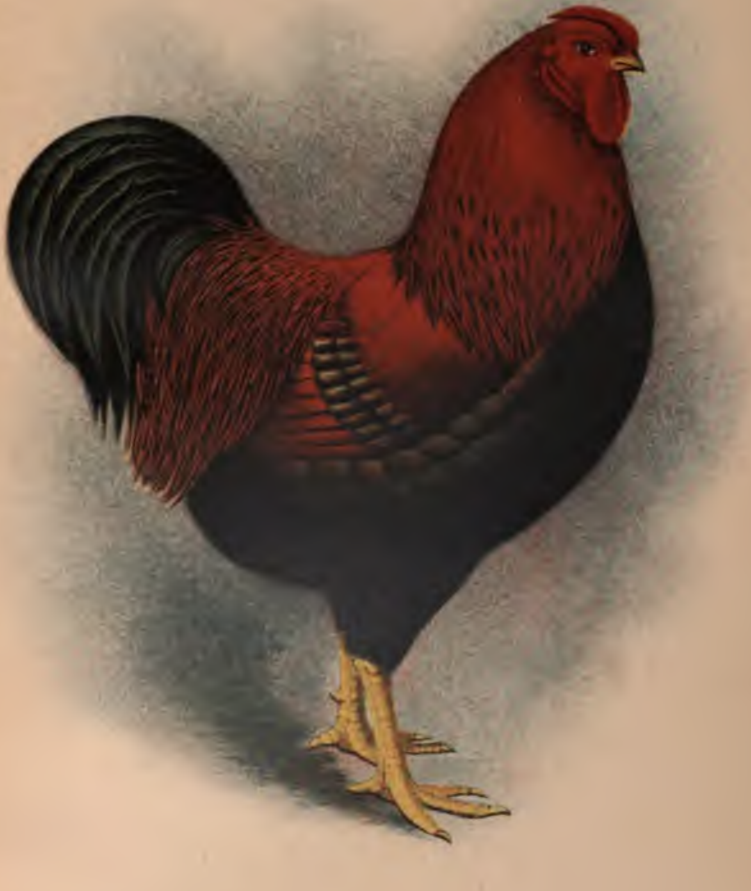
PENCILED WYANDOTTES.

Having forced themselves into distinguishing classes, the Silver and Golden Wyandottes are known as the Silver-Laced and Golden-Laced varieties, from the fact that their plumage has an edging of black about each feather which is known as lacing. Two varieties are now demanding recognition that have penciled plumage.

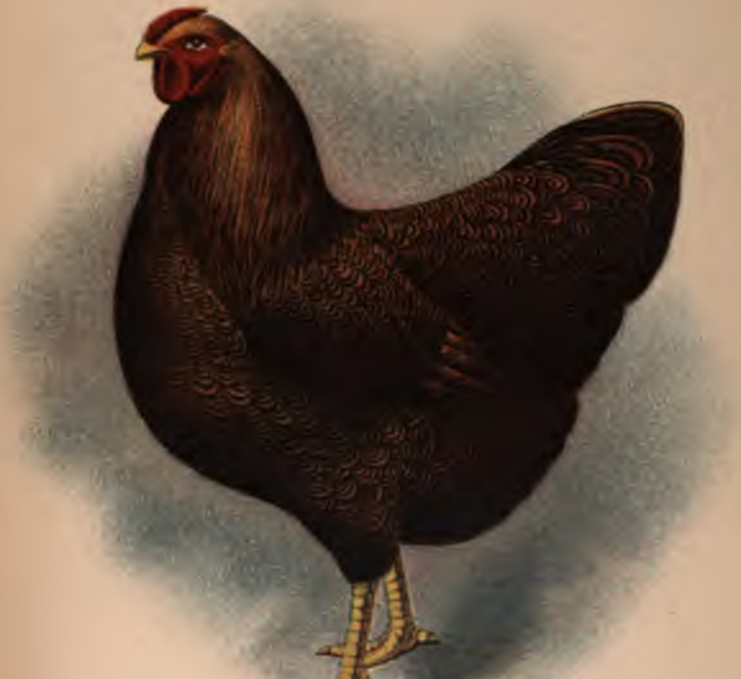
If proper uniformity in the Standard is to be maintained the line should be drawn between the laced and penciled varieties. All laced varieties should be grouped under one head and the penciled varieties under another head. This would form a guide for uniformity in the Standard, and cover all varieties that now or hereafter may seek admission. We have the Buff Laced, as well as others yet unnamed, that are gaining in quality each year. These should have provision made for them in advance, so that a uniformity of standard may be observed in their construction.

GOLDEN-PENCILED, OR PARTRIDGE, WYANDOTTE.

This, the first penciled Wyandotte, is the result of crosses made in 1889 by George H. Brackenbury, of Auburn, N. Y., who used a Golden Wyandotte male and a Pea-Combed Partridge Cochin female for his start. About the same time Joseph McKeen, of Omro, Wis., and his coworker, E. O. Thiem, put forth efforts for the same result, using Golden Wyandotte and Partridge Cochin crosses. These three men should have the credit of the origin of the Golden-Penciled Wyandotte. Future results only will prove who are the most competent in the advancement of this strain. Every time a new variety is produced contention arises as to whom the credit of its origin should be accorded. If better records of time and matings were kept they would be proof in the case.



GOLDEN PENCILED WYANDOTTE MALE.



GOLDEN PENCILED WYANDOTTE FEMALE.

This new Wyandotte has, or should have, the same color and markings in all sections as the Partridge Cochin fowl. In size, shape, and comb it must conform to the Standard demands for all Wyandottes. It should be a Wyandotte of perfect form, clothed in the beautiful plumage of the Partridge Cochin.

The production of good color and markings for this new variety is not an easy task. The color demanded for the Partridge Cochin makes it almost impossible to produce good exhibition males and females from the same matings. As the new Wyandotte advances in quality the same difficulties will confront it that confronted the Cochin, and the same methods must be applied as are now used to produce the exhibition Cochin, unless some of those who are engaged in the improvement of the Penciled Wyandotte devise a plan of mating that will produce males and females of equal quality from the single mating. Until the Standard for this variety is formed and accepted it can be considered only under the description published by the originators.

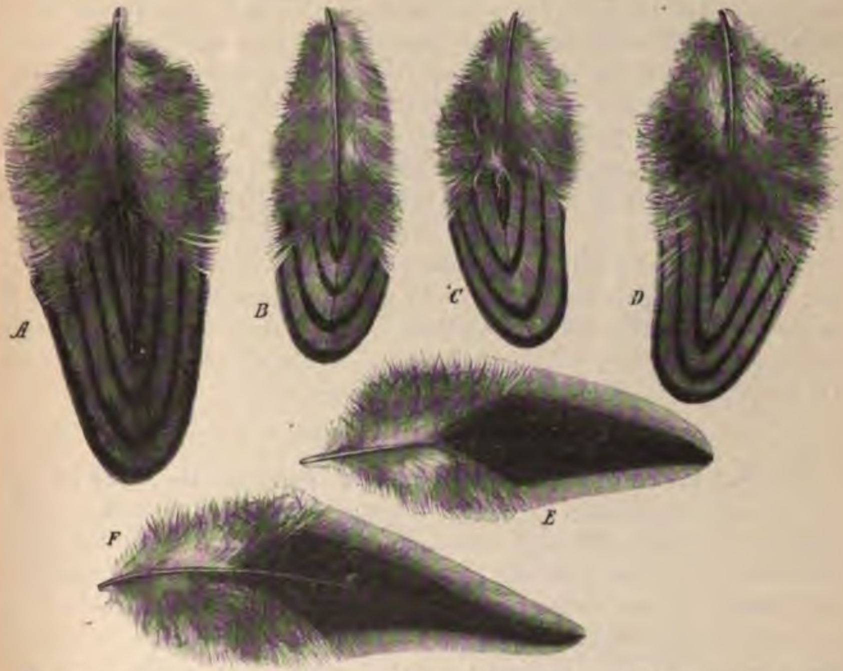


FIG. 224.—Feathers of Partridge Wyandotte.* *A*, fluff, female; *B*, breast, female; *C*, wing, female; *D*, cape, female; *E*, hackle, female; *F*, hackle, male.

NOTE.—Since the above was written this variety of Wyandottes has been admitted to the Standard under the name of Partridge Wyandotte. This was done at the meeting of the American Poultry Association, at Chicago, on January 23, 1901. The Standard description of the variety demands that they have the true Wyandotte shape, while the color is the same as for Partridge Cochins.

SILVER-PENCILED WYANDOTTE.

This variety also originated with Mr. Brackenbury. It is the result of a Wyandotte-Dark Brahma cross. They are true Wyandottes, and have the color and markings of the Dark Brahma; the topcolor of the male, silvery white; hackle and saddle striped with black; breast and undercolor of body a beautiful rich glossy black; beak and shanks yellow. The female is a beautiful clear gray, nicely penciled with the darker color. This variety promises to be one of our most beautiful fowls. The attractiveness of color and markings add greatly to the admirable Wyandotte form.

It is to be hoped that the bad color of the back, so prevalent in the Silver-Laced, will not be present in this new variety, as their beauty depends so largely upon clearness of plumage, which can be easily marred by the presence of the reddish brown cast too often seen in the Silver-Laced males. The efforts of their champions to breed both these penciled varieties with yellow shanks will no doubt retard them somewhat, as it did the blacks. They should at least have as much latitude for color as the Cochin and Brahma, from which they are derived.

Both the Silver-Penciled and the Golden-Penciled are clear in color and beautifully penciled. In the former the black and white are well defined. The striping of hackle and saddle in each is very prominent and true, while the penciling and color of some of the Golden females are almost the equal of that of the Partridge Cochin.

THE BUFF-LACED WYANDOTTE.

The Buff-Laced variety has the true buff center and the white lacing, or edging, on plumage, exactly like the Buff-Laced Polish. They came as the result of some of the many crosses made to establish other varieties. In order that the readers may know more of the matings and crosses of this variety, there are given below the exact words of one who helped in originating it: "From a combination of blood, made from a Golden Wyandotte-Buff Cochin cross, mated to White Wyandotte-Buff Cochin cross-breds, a cockerel sported having the two colors of the Buff-Laced birds. His breast, fluff, and wing bars were laced with white as perfectly as any laced Wyandotte male I ever saw. His wing bows and all the centers of his entire plumage were of the same deep red-bay color. The white lacing was as white as is seen in any white variety. This buff-laced male was bred to a pen of the blue-laced females, to lighten the color of the lacing. From this was obtained one beautiful pullet from which was developed this variety." From these many crosses other colors also made their appearance, as mentioned above; for instance, the blue-laced females, which are sometimes called violet laced. Other crosses produced the Buff-Laced variety, as follows: By crossing Golden-Laced and White Wyandottes, and remating the best results of these matings, the foundation of one of the most successful strains was laid. Another came as a by-product from an attempt to produce blue lacing upon a golden colored Wyandotte. Some specimens came with the golden centers and white lacing, giving the foundation for one of the best-known strains of the world. All these many crosses brought the same final result, namely, showing the possibilities of manipulating the shades of color and their numerous markings.

A reasonably perfect specimen of this variety is a most beautiful fowl. The center of the plumage should be a rich golden buff nicely laced about with white. Thus far but a limited number has been produced which has the desirable qualities.

THE UNNAMED VARIETIES OF WYANDOTTES.

The most prominent of the unnamed varieties is a fowl of a Wyandotte shape having the color and marking of the Light Brahma. It is known as the Columbia Wyandotte. Its style of color and marking has not so far attracted public attention. Great improvement has been made in the variety within the last two years, and its general make-up in form and color could be directed into a most beautiful specimen of the Wyandotte family. Evidently these fowls originated from a White Wyandotte-Light Brahma cross. The rich yellow of beak and shanks will come very naturally to them, and the striping of hackle, when it becomes equal to the same section of the highly colored Brahma, will be an attractive contrast with their white bodies.

The Violette, or Violet-Laced Wyandotte, is of the same shade and color as the Golden-Laced, except that it has the blue instead of the black lacing. When this lacing is of a rich violet blue the coloring is attractive. This variety was produced by crossing and recrossing the Wyandotte varieties and selecting the best. Much trouble is always experienced in attempting to hold these colors true. In fact they are Wyandottes of a much too delicate color formation to be other than an extremely fancy fowl.

Cuckoo Wyandotte.—In England they have a Wyandotte of the same color as our Barred Plymouth Rocks which they call Cuckoo Wyandottes. So far they have gained but little prominence in their own country and none have been seen in this excepting those often shown in our American Dominique classes. They favor our Wyandottes too much both in form and color. In addition to this, the long flowing tail of the properly constructed Dominique is, in too many cases, misplaced by the Wyandotte form of tail.

Some other colors.—If the Pile-colored Wyandotte could be produced in as delicate tints as the Pile Game, it would add another variety to the truly fancy Wyandotte list. Among the newest is a fowl of Wyandotte shape, with broken black-and-white plumage, like the Ancora or Houdan. This fowl is presumed to be related to the Erminetts, a fowl of much the same character that has been bred in New England for years.

A VARIETY OF THE HOG CHOLERA BACILLUS WHICH CLOSELY RESEMBLES BACILLUS TYPHOSUS.

By M. Dorset, M. D.,
Assistant Chief of Biochemic Division, Bureau of Animal Industry.

Variations in the cultural features and pathogenic powers of many of the disease-producing bacteria are so frequently encountered that it is seldom that half a dozen cultures of the same organism from different sources will agree in all particulars. This is especially true of the hog cholera group of bacteria, a number of varieties of which have been described by Smith,[a] who found the widest variation in pathogenesis and many departures from the typical growth in bouillon and on gelatine plates. Moore[b] has also described a nonmotile variety of the hog cholera bacillus. In the course of an extensive study of hog cholera bacilli, which is now in progress in this laboratory, under the direction of Dr. E. A. de Schweinitz, many varieties have been encountered.

The interest attaching to these variations in the hog cholera bacillus is very much increased when they indicate a tendency to approach more nearly the allied races of colon and typhoid bacilli, and it is for this reason that the description of the bacillus herein described is published separately. This organism has been designated *Bacillus 118*, and was isolated from the spleen of a sick pig belonging to a herd of swine in Page County, Iowa.

The first signs of disease in the herd were noticed on October 5, 1899, and by November 11, 1899, the disease had run its course, having caused a loss of 31 animals out of a total of 44 in the herd. The postmortem examinations of the pig killed for that purpose, and from which our cultures were taken, showed portions of the large and small intestines inflamed and both kidneys congested. The liver was dotted with areas of coagulation necrosis, spleen enlarged, soft, and dark. The lungs were highly congested, and there was one large hepatized area in the right lung. There were a number of small hemorrhages to be seen on the surface of the lungs. From these postmortem appearances, and from the rapidly fatal character of the disease, the diagnosis of hog cholera, acute type, was made by the veterinarian conducting the field work.[c]

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[a] Bulletin No. 6, Bu. An. Ind., U. S. Dept. Agric.

[b] Bulletin No. 3, Bu. An. Ind., U. S. Dept. Agric.

[c] The postmortem examination and field notes were made by Dr. Chas. M. Day.

A guinea pig inoculated subcutaneously with a bouillon culture made from the original agar stab succumbed on the fifth day, and from the liver of this guinea pig there was obtained in pure culture a small actively motile bacillus, which is the subject of this paper.

Before entering upon a detailed description of the morphological and biological characters of the bacillus, it may be well to call attention to the fact that during the eighteen months that it has been under cultivation on various media it has undergone no perceptible variation.

Morphology.—Small bacilli, with rounded ends, usually appearing singly, though sometimes in pairs, never in chains. The length in twenty-four-hour agar cultures is from 1 to 2 μ. and breadth from 0.5 to 0.8 μ. The dimensions are practically the same in fresh gelatine and beef broth cultures, though they are possibly slightly greater in both measurements in cultures on the latter medium. In old gelatine stab cultures (twenty days at 22° C.) the average length is from 1.5 u. to 2.5 μ. There are a few individuals in these old gelatine cultures whose length is as great as 24 μ. These longer forms, as stated above, are not numerous and take the stain about as well as the smaller forms.

Staining powers.—These bacilli stain readily with watery solutions of the ordinary aniline dyes. They do not stain by Gram's method.

Motility.—They are actively motile, and the individuals possess several flagella.

No spores could be demonstrated.

BIOLOGICAL CHARACTERS.

Neutral bouillon (*neutral to phenolphthalein*).—Cultures grown twenty-four hours at 37° C. give a fairly abundant growth. There is a uniform cloudiness throughout the medium and a very slight sediment in the bottom of the tube, but no surface film. The growth at 22° C. is almost identical with that at 37.5° C, though possibly not quite so vigorous.

Acid bouillon (*2.8 per cent acid to phenolphthalein*).—Cultures grown twenty-four hours at 37° C. show a very slight diffuse cloudiness, no surface film, and practically no sediment. The growth is not so abundant as on the neutral bouillon.

Gelatine plates (*15 per cent gelatine, neutral to phenolphthalein*).—Colonies visible at the end of forty-eight hours. At the end of five days the surface colonies are from 4 to 6 mm. in diameter, round, flat, and semitransparent, bluish by reflected light, and have sharply defined irregular margins. Magnified about ten diameters, the surface is seen to be slightly irregular, the undulations extending generally in a radial direction. The colony is made up of very fine wavy lines, in great part, although some portions are granular. The center is very slightly thicker than the body of the colony, and the margins are quite thin. The colony resembles the typhoid colonies very closely, though it is perhaps a trifle thicker. The deep colonies are very small and round or oval, nearly opaque, with slightly lighter center than circumference.

Gelatine stab cultures (12 per cent gelatine, neutral to phenolphthalein).—The growth in gelatine stab cultures, which becomes visible in twenty-four to thirty-six hours, at the room temperature of about 22° C., extends to the bottom of the needle track, where it is not so abundant as nearer the surface, and where separate round colonies are more distinctly seen. The surface growth at the end of fourteen days is white and flat, with irregular margins, and is from 5 to 12 mm. in diameter. The gelatine is not liquefied.

Agar plates (1.25 per cent agar; neutral to phenolphthalein).—Grayish white colonies are seen on surface of plates kept at 37.5° C. for twenty-four hours. The colonies are irregular in shape and tend to spread rapidly over the entire surface. There is nothing characteristic about their appearance. The deep colonies appear as small round white dots.

Agar slant cultures (1.25 per cent agar; neutral to phenolphthalein).—At 37.5° C. there is an abundant, moist, grayish white growth in twenty-four hours. The water of condensation is clouded.

Agar stab cultures (1.25 per cent agar; neutral to phenolphthalein).—At 37.5° C. there is an abundant growth to bottom of needle track, and grayish white growth over the surface at the end of twenty-four hours.

Potato cultures.—The appearance of the growth on potato depends upon the reaction of the potato. In some cases the growth is abundant and yellowish brown, while in others the growth is scarcely visible, showing simply a moist line following the track of the inoculation.

Ordinary milk (not over 1.5 per cent acid to phenolphthalein).—No change visible until about the end of two weeks, when the tubes have become brownish in appearance. There is no coagulation, and the reaction is alkaline. No odor and no change upon boiling.

Litmus milk (not over 1.5 per cent acid to phenolphthalein).—The color is usually about neutral. At the end of two days at 37° to 38° C. the tubes are red; they then gradually change to blue, first becoming neutral again and a light blue by the seventh day. This blue gradually becomes deeper, and by the end of two weeks it is a deep indigo blue. There is no coagulation of the milk and no perceptible odor. No change in appearance occurs upon boiling, but a faint sweetish odor is given off.

Action upon carbohydrates.—1. Glucose broth (1 per cent glucose; neutral to phenolphthalein): No gas is produced after ten days at 37.5° C. There is growth in both the open and closed arms of the fermentation tube, and the fluid in the tube has a strongly acid reaction.

2. Lactose broth (1 per cent lactose; neutral to phenolphthalein): No gas is produced. The fluid in the tube is neutral or slightly alkaline.

3. Saccharose broth (1 per cent saccharose; neutral to phenolphthalein): No gas is produced. The fluid in the tube is neutral or slightly alkaline.

Action upon nitrates (*broth according to Method B. C.*[a]).—In cultures kept at the room temperature (about 22° C.) a very decided reduction of the nitrates to nitrites is found by the naphthylamine and sulphanilic acid test. Whether or not the reduction will continue further to the formation of ammonia has been left for future determination.

Production of indol.—The culture fluid used for this test was the sugar free broth recommended by Smith.[b] The medium was rendered exactly neutral before inoculation. Series of tubes were inoculated and tests were made on the third, fifth, seventh, and twelfth days. All tests for indol were negative.

Agglutination reactions.—Agglutination tests made with the dried blood from guinea pigs, inoculated with *Bacillus 118* have all been negative, although specimens were taken at different times after inoculation, and in one instance just preceding death. A specimen of blood from a patient suffering with typhoid fever also failed to agglutinate *Bacillus 118.*

Pathogenesis.—Pathogenic for swine, rabbits, and guinea pigs. A hog which received one-half cubic centimeter of a twenty-four-hour bouillon culture intravenously died in four days, and guinea pigs and rabbits which received one-twelfth cubic centimeter of the same culture subcutaneously died in from four to eight days. The autopsies on the above animals revealed the lesions usually seen after inoculation with a virulent hog cholera bacillus. In the rabbits and guinea pigs there was considerable inflammation surrounding the point of inoculation, and some areas of necrosis on the surface of the liver. The spleen was considerably enlarged, and in guinea pigs frequently showed miliary necrotic areas on the surface. Lungs usually congested. This bacillus is apparently as virulent to-day, eighteen months since its isolation, as it has ever been. At one time it was cultivated for eight months without being passed through an animal, but at the end of that time its virulence was not diminished.

It will be seen from the foregoing description that the only striking variation from the typical hog cholera bacillus which *Bacillus 118* displays is in the character of its fermentation of glucose, which takes place without gas production. While a variation of this kind might not be considered of very great importance when found in some other bacilli, it is nevertheless of considerable interest when found in a member of the hog cholera group of bacteria, for the reason that the fermentative characters of the latter group have been considered con-

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[a] The method recommended by the committee of American bacteriologists: Peptone, 1 gram; potass. nitrate, 0.2 gram; water, 1,000 c.c.

[b] Jour. of Experimental Med., Vol. II, p. 543.

A table comparing *Bacillus 118*, *Bacillus typhosus*, and a typical hog cholera bacillus, follows:

Name of organism.	Morphology.				Biology.																				
					Cultural features.							Biochemical features.												Agglutination reactions.	Pathogenesis.
					Nutrient broth tube.		Nutrient agar tube.		Potato tube.		Fermentation tube.					Milk tubes.		Gas production.							Guinea pigs.
	Bacillus.	Diameter greater than 1 μ.	Motility.	Spores.	Pellicle.	Turbidity.	Dull.	Wrinkled.	Visible.	Luxuriant.	Growth in closed arm.	Grows at body temperature.	Facultative anaërobe.	Affected by range of reaction.	Gelatin liquefied.	Coagulated.	Reaction alkaline.	Dextrose broth.	Nitrate reduced.	Indol produced.	Characteristic odor.	Chromogenesis.	Fluorescence.	Widal reaction with typhoid blood.	Subcutaneous inoculation of ¼ c. c. caused death.
Bacillus 118	+	–	+	–	–	+	–	–	+	+	+	+	+	+	–	–	+	–	+	–	–	–	–	–	+
B. Typhosus 162	–	–	+	–	+	+	–	–	+	±	–	+	+	+	–	–	+	–	+	–	–	–	–	+	–
B. Typhosus II	+	–	+	–	+	+	–	–	+	±	+	+	+	+	–	–	–	–	+	–	–	–	–	......	–
B. Typhosus V	+	–	+	–	±	+	–	–	+	±	+	+	+	+	–	–	–	–	+	–	–	–	–	+ –	–
B. Choleræ Suis C	+	–	+	–	–	+	–	–	+	+	+	+	+	+	–	–	+	+	+	–	–	–	–	......	+

+ = positive reaction.
– = negative reaction.
± = varying reaction.
+ – = uncertain reaction.

NOTE ON BRANCHED FORMS OF TUBERCLE BACILLI FOUND IN CULTURES.

By M. Dorset, M. D.,
Assistant Chief of Biochemic Division, Bureau of Animal Industry.

Branched forms of the tubercle bacilli have been observed in cultures and in sputa of tuberculous patients by a number of workers. Coppen-Jones[a] has given much attention to the occurrence of branching tubercle bacilli and reports finding constantly in glycerine agar cultures, which were three to four months old, branching and irregular forms of the tubercle bacillus. De Schweinitz and Dorset[b] also noted many irregular forms in young cultures of the human bacillus grown on acid media, though no distinct branched forms were seen. The forms described in this note (fig. 225) were observed in a glycerine bouillon culture of the human tubercle bacillus which was just six weeks old.[c] This culture remained about four weeks in the thermostat, at which time it was set aside on one of the laboratory tables and left there for two weeks. At the time of the removal from the thermostat the culture was perfectly normal in appearance, while at the time this observation was made, instead of the usual rough, flat film extending evenly over the surface of the bouillon, there was a small portion about one-half inch in diameter which projected above the surface of the medium about one-fourth inch and which had a bleb-like appearance. Closer examination showed a fungus-like growth on the under surface of this bleb. Cover-glass preparations from the bleb showed the contaminating organism to be probably a form of streptothrix. The tubercle bacilli stained well with carbol-fuchsin and were quite irregular in shape, size, and the manner in which they took up the staining fluid. There were many long filaments, short rods, and branching forms, and in many the so-called "beading" was very pro-

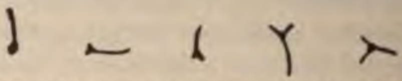

Fig. 225.—Branched forms of tubercle bacilli.

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[a] Centralb. f. Bakt. u. Parasit., 1893, 1895, and 1896.

[b] Bulletin No. 13, Bu. An. Ind., U. S. Dept. Agric.

[c] The culture was six weeks old, although this organism has been cultivated upon artificial media more than two years.

nounced. In all of these branching forms the rod appeared to have divided at the end, producing a Y-shaped body.

A glance at the figure will show the way in which the branches appear to have been formed. The various forms shown here were observed in different portions of the field, and were drawn by Mr. Haines with the aid of the camera lucida. They have been so arranged as to show the successive stages in the process of branching as it appears to have taken place, beginning with the enlarged, swollen, and deeply stained end of a rod and the first signs of division at this swollen end, and ending at a point where the branches have attained a length nearly equal to that of the parent rod. No secondary branches were found. It will be seen from the figure that the rod was almost always thickened and stained deeply at the point from which the branches were given off. Other cultures of this same tubercle bacillus grown upon the same medium and of the same age, but which were not contaminated, were examined, but no branched forms could be found.

It is not the purpose of this note to attempt an explanation of the cause or significance of these branched forms, but simply to record the observation with the hope that it may form a slight addition to our knowledge of the life history of the tubercle bacillus. It is hoped that the opportunity will present itself at some future time to identify the particular streptothrix found in this culture and to ascertain what influence if any its presence had upon the branching of the tubercle bacillus.

THE USE OF EGGS AS A MEDIUM FOR THE CULTIVATION OF BACILLUS TUBERCULOSIS.[a]

By M. Dorset, M. D.,
Assistant Chief of Biochemic Division, Bureau of Animal Industry.

The cultivation of tubercle bacilli upon artificial media directly from animal tissues has always been a matter of difficulty, although many widely different culture media have been recommended for this purpose. Little advance has been made over the original slow and troublesome blood-serum method of Koch, unless the recently described brain agar and brain serum of Ficker,[b] which gave such abundant growths from pure cultures, has proved in the hands of some to be equally satisfactory when attempts are made to cultivate the tubercle bacillus directly from the tissues of tuberculous animals.

The large number of tuberculosis experiments now under way in this laboratory, under the general direction of Dr. E. A. de Schweinitz, has made it desirable to obtain a more certain, rapid, and less troublesome method for cultivating *Bacillus tuberculosis* than the blood-serum method upon which we have heretofore relied. No animal substance seemed to possess so many of the desired qualities as eggs, which are rich in proteids and the glycerids of the fatty acids and also phosphoric acid, which very necessary substance is present in the easily assimilable form of glycerophosphoric acid and its salt, lecithin. In addition the egg can be readily coagulated by heat in a blood-serum oven. A medium consisting solely of the coagulated contents of hens' eggs was therefore prepared, and it has given such uniformly good results in this laboratory, is so much more easily prepared, and the growth of *Bacillus tuberculosis* has appeared so much more rapidly than on the hardened dogs' serum which we have been accustomed to use, that it has been thought best to publish now a description of the method and a statement of the results thus far obtained.

After this method had been in use for some time, and after the work herein described was practically complete, my attention was called on looking over the literature, to the paper of Capaldi[c] on the addition of egg yolk to culture media. He prepared his medium by the addition of three or four loops of sterile egg yolk to agar which had been melted and cooled to 45° to 47° C. The yolk was mixed well with the agar and the tubes allowed to harden in an inclined position. This medium has been used by Capaldi chiefly for the cultivation of the diphtheria bacillus, although he says that tubercle bacilli grow as well upon the egg yolk agar as upon blood serum.

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[a] Reprinted from "American Medicine," Vol. III, No. 14, p. 555–556, April 5, 1902.

[b] Centralbl. f. Bakt., etc., 1900, Abt. 1, Bd. xxvii, No. 14–15, p. 504, and No. 16–17, p. 591.

[c] Centralbl. f. Bakt., etc., 1896, Abt. 1, Bd. xx, pp. 800–803.

Nastiukoff[a] employed media made from eggs for the cultivation of pathogenic organisms, but makes no mention of having attempted to cultivate the tubercle bacillus upon them.

I have also understood indirectly from conversation that one of Dr. Adami's former pupils, while working abroad, used an egg medium quite similar to Capaldi's, but his results were never published.

I have used three different media, consisting of portions of hens' eggs, as follows:

1. The whole egg contents, white and yolk mixed.
2. The yolk of the egg separated so far as possible from the white.
3. The white of the egg alone.

Perfectly fresh eggs were generally used and seemed to give slightly more rapid growths than older eggs, though quite abundant growths were obtained from eggs of uncertain age purchased at a grocery store, which, however, were apparently fresh. I prefer eggs not more than one week old, or which are not more than 2 per cent acid to phenolphthalein.

1. *The whole egg contents.*—The eggshell is broken carefully, and the entire contents dropped into a wide-mouthed sterile flask. The yolk may be broken with a sterile platinum wire. Gentle shaking of the flask will now serve to mix the white and yolk of the egg quite thoroughly. Care should be taken, however, not to shake the flask so much that a foam will be produced, otherwise an uneven and unsatisfactory surface will be obtained when the medium is hardened[b]. When the mixing is complete, the egg is poured into tubes, care being taken to avoid foaming, and the tubes, containing about 10 c. c. of the medium are then inclined in a blood-serum oven and hardened at a temperature of 70° C. This hardening will usually require two days, four or five hours each day. Sterilization will be accomplished at the same time. A higher temperature may be used and the medium be hardened much more quickly. The growths of the tubercle bacillus have seemed to be more vigorous when the egg is hardened at 70°-74° C., and, in addition, the prolonged heating probably insures a more certain sterilization. The medium after hardening is opaque, and yellowish in color, and usually dry, there being practically no water of condensation in the tube. The egg tubes should be kept in an ice box to prevent further drying. Just before inoculation, three or four drops of sterile distilled water should be added to each tube to supply the moisture required for the satisfactory development of the tubercle bacillus.

2. *The egg-yolk medium.*—In making the yolk tubes the egg yolk is separated from

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[a] Vratch, 1893, No. 33 and 34, Review in Centralbl. f. Bakt., etc., 1895, Abt. 1, Bd. xvii, p. 492.

[b] Since the preparation of this paper it has been found that straining the medium through a cloth removes the foam completely, and, in addition, gives a more homogeneous medium.

the white as well as possible and dropped into a sterile flask. The yolk alone is quite viscid, and I have found it desirable to add to the yolks of 3 or 4 eggs 5 or 10 c. c. of sterile water, in order that this medium may be of practically the same consistency as the whole-egg medium before heating. The egg-yolk medium is put into tubes, inclined, hardened, and water added before inoculation, just as in the case of the whole-egg medium.

3. The medium made from the white of the egg.—Negative results were always obtained when the white of the egg alone was used as a culture medium, so it will not be considered further.

In all of the eggs I have used, the white of the egg has been alkaline and the yolk acid to phenolphthalein. The degree of acidity or alkalinity of these two substances appears to vary considerably in the case of different eggs, and, as a rule, the older the egg the less alkaline the white and the more acid the yolk becomes, so far as I have examined them. In most cases in which the whole egg has been used the medium has been found to be slightly acid to phenolphthalein, 100 c. c. of the mixture requiring from 1 to 2 c. c. of normal sodium hydrate solution to neutralize it. In the light of observations upon other media this is probably the optimum reaction for the tubercle bacillus, and the whole egg is thus well suited for *Bacillus tuberculosis* on account of its reaction as well as its chemic constitution, although, as will be shown later, I have obtained cultures from guinea pigs upon the egg yolk alone when the reaction was +6 per cent to phenolphthalein.

The cultures from guinea pigs have been made in the following manner: A small tuberculous focus in the spleen was torn out with sterile forceps and crushed as well as possible between the prongs of the forceps. It was then transferred upon a platinum loop to the egg in the culture tube and rubbed well over the surface, care being used to avoid breaking the egg and the bit of tissue being allowed to remain in the tube. I have, as a rule, used bits of tissue about 2 mm. in diameter. The cotton plug of the culture tube is now cut off even with the mouth of the tube, the upper portion saturated with paraffin, and the tube completely sealed with the paraffin. The tubes are then placed in an incubator at 38° C. in an inclined position, so that the surface of the culture medium may be kept moist.

Owing to the opaque character of the medium and the color, which is frequently almost white, it is difficult to say at what time the growth would be sufficiently far advanced to be seen if the medium were transparent, but at the end of seven or eight days I have usually been able to see upon the whole-egg medium minute tubercles, dotted over the surface of the egg, or a slightly dull, ground-glass appearance around the bit of tissue which was placed in the tube. Carefully made cover-glass preparations have shown a distinct increase in the number of tubercle bacilli by the end of the third day upon the whole-egg medium, and on the fourth, fifth, or sixth day I have found the characteristic rope-like portions of colonies, the quantity of growth depending in great part, no doubt, upon the number of tubercle bacilli in the tissues.

The colonies of tubercle bacilli gradually increase in size from the minute dots which are first seen, until by the tenth or fourteenth day they are very apparent, round, white, slightly elevated points all over the surface of the medium; in fact, from the appearance of the growths and the number of bacilli introduced, as shown by smear preparations, I am inclined to believe that practically all active bacilli introduced, no matter how isolated they may be, are able to multiply upon this medium.

Cultures upon the whole-egg medium have been made from 16 guinea pigs. Nine of these animals were inoculated with human tuberculous material or a pure culture, 4 with a bovine culture, 2 with a swine culture, and 1 with a culture of horse tuberculosis. From 15 of these animals I have obtained growths easily visible in ten days, and some were quite abundant, the colonies having coalesced and formed a layer over the surface of the medium. The one failure was in the case of one of the bovine guinea pigs. This animal died within two weeks of the date of subcutaneous inoculation, and, although the spleen was large, very few tubercle bacilli were found in smears from that organ. The cultures developed a rather abundant growth of a streptococcus in a day or two, and the failure of the tubercle bacillus to develop was no doubt due to the presence of this organism.

The colonies upon the egg yolk do not develop so rapidly as upon the whole egg, nor is the growth so abundant, but the colonies can usually be seen at the end of two weeks. I have made cultures upon egg yolk from only five guinea pigs, and from all of them I obtained a slow and scanty growth, consisting of minute colonies scattered over the surface. This failure of the tubercle bacillus to grow so well upon the egg yolk alone may be due to the greater acidity of the egg yolk, which was enough to require 5.5 to 6 c. c. of normal sodium hydrate solution to neutralize 100 c. c., using phenolphthalein as an indicator.

I have compared the egg medium only with hardened dog's serum. Potato and glycerinized agar are so much poorer than the serum that they were not considered.

I regret that a lack of time has prevented a comparison with Ficker's acid brain media. He gives results with the use of a pure culture only and makes no mention of having attempted to cultivate tubercle bacilli direct from the animal body upon his brain agar and brain serum.

The effect of the egg medium upon the morphology and virulence of the several varieties of tubercle bacilli has not been determined definitely. Both of the cultures from guinea pigs inoculated with a swine-tuberculosis culture showed many long individuals in which the beaded staining was so prominent that they resembled short chains of streptococci. In the case of egg cultures made from pure cultures on beef broth of human and bovine tuberculosis, a decided shortening of the human bacillus has been noted. This was especially true of an attenuated human culture which had been growing upon artificial media for a long time and had always been long and slender. Upon an egg-yolk culture, first generation, the individuals were rendered extremely short, in some cases resembling micrococci. No conclusions can be drawn from this observation, however, as it will, of course, be necessary to cultivate the organism upon the egg for a number of generations in order to establish the modifications, if any, which are produced in its form. It has been interesting to note in cultures two weeks or more old the sucking in of the paraffined plugs, which is no doubt due to a consumption of the oxygen within the tube.

I have not obtained upon the egg such rapid and abundant growth as Ficker secured from pure cultures upon the brain medium, but it must be remembered that all of my cultures were made directly from animal tissues, and a comparatively small number of bacilli were introduced in this way. In addition, the tubercle bacilli were being required to establish a saprophytic existence.

The egg medium is so easily prepared, and a growth of the tubercle bacillus can be expected so quickly and with such comparative certainty in cultures made upon it, that I believe it will be found to be of value to those engaged in experimental work in connection with the study of the organism which is at present exciting such general interest.

VIRULENCE OF THE BOVINE TUBERCULOSIS BACILLUS FOR MONKEYS

And the Effect of Tuberculins Made from Tuberculosis Bacilli Derived from Different Animals.[a]

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AND
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In order to determine some points which would apparently throw light upon the virulence of the tuberculosis bacilli derived from cattle, for man, as experiments directly upon man are impracticable, it occurred to one of us (de Schweinitz) several years ago that some information might be gained by trying the effect of these germs upon monkeys. At that time other matters interfered with the rapid pushing of this work, so that the experiments which were originally planned in 1899 are being carried out only at the present time.

It would seem very strange, indeed, if the bovine tuberculosis bacillus, which, it is well known, is more virulent than the human germ for various species of animals upon which it has been tried, should suddenly become less virulent, when another animal, man, is exposed to its influence.

The experiments recorded here in brief, a more detailed account of which will be subsequently printed in a bulletin of this Department, appear to confirm our suppositions in this respect.

The bovine culture which we used was obtained several years ago from Dr. Theobald Smith, of Boston, and since that time has been grown for a number of generations upon artificial liquid culture media.

The varieties of monkeys with which we experimented were the following: Baboons, rhesus, and an American ringtail monkey. All these animals were tested with tuberculin to prove the absence of tuberculosis and kept for several weeks under close observation, and appeared to be perfectly healthy. The animals were kept in large cages in a new, large, specially constructed house, carefully isolated, so that one animal could not contract disease from another.

September 12, 1901, No. 1.—An African female baboon was injected subcutaneously with 1 c. c. of bovine tubercle culture. The injection was made in the subcutaneous tissue on the left side, the weight of the animal at the time being 8 pounds 9 ounces.

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[a] Reprinted from American Medicine, January 4, 1902.

In a few days a tumor formed at the seat of injection. It was at first hard and increased rapidly in size, softened, broke and discharged a creamy pus-like substance. The wound was washed with a solution of carbolic acid and kept covered with a layer of powdered chalk and alum, as the animal tried to pick continually at the wound.

October 4.—The axillary lymph gland on the side of the injection had become prominent and hard.

October 12.—The weight of the monkey had decreased to 7 pounds 15 ounces.

October 26.—The animal was very weak and depressed, had no appetite, and the weight had decreased to 7 pounds.

October 29.—She was much weaker and could scarcely sit with body erect.

October 30.—She was unable to climb upon the perch in the cage, and was chloroformed for autopsy. The autopsy proved the presence of generalized tuberculosis, all the organs being infected and literally filled with tubercles.

September 12, 1901, No. 2.—A small American ringtail male monkey was inoculated with ½ c. c. of the same tubercle culture as that used for the baboon. The weight at the time of injection was 2 pounds 1 ounce.

October 12.—Weight was 1 pound 14 ounces.

October 29.—He was bright and lively, but the appetite was not good.

November 7.—The weight was only 1 pound 12½ ounces.

November 22.—The animal was found on the floor of his cage in an apparently dying condition, and was hence chloroformed. The autopsy showed the presence of considerable tuberculosis, but not nearly so generalized as that noted in the baboon. Although proportionate to its weight this animal had received the larger quantity of the tuberculosis culture, it seemed to show a greater resistance.

This would agree with our supposition that the bovine bacilli are even more virulent for the animals more closely allied to man than for those nearer the lower animals. As these two tests had shown the extreme susceptibility of the monkeys to the bovine bacilli, we next started two comparative tests.

November 7, 1901.—Male baboon, No. 4, received subcutaneously on the inner side of the right thigh 1 c. c. of the same bovine tubercle culture as that used above. The weight of the animal at the time was 9 pounds 12 ounces. As in the inoculation of the first baboon an ulcer was formed at the seat of injection.

December 4.—The inguinal gland had become considerably enlarged, the animal was troubled with spells of coughing and was not nearly so lively as he was previous to the inoculation. His weight on this date was 9 pounds 9 ounces. Dead December 23, 1901. Generalized tuberculosis.

November 7, 1901.—Female baboon, No. 3, weight 9 pounds 8 ounces, was inoculated with 1 c. c. of human tubercle culture. An ulcer in this case was also formed at the seat of the inoculation.

December 4.—The inguinal gland near the seat of injection had become greatly enlarged. The monkey coughed considerably and was quite depressed. The weight at this time was 7 pounds 14 ounces. Dead December 30, 1901. Generalized tuberculosis.

November 7, 1901.—Male rhesus, No. 5, was injected with 1 c. c. of virulent human tubercle culture. The weight was 5 pounds 11½ ounces.

November 20.—An abscess had formed at the seat of inoculation.

December 4.—The weight of the animal had decreased to 5 pounds 2 ounces, and although the inguinal gland near the seat of inoculation was hard and enlarged, the animal seemed to be in fairly good health.

December 21.—This animal was dead from tuberculosis.

November 7, 1901.—Female rhesus, No. 6, received an injection subcutaneously on the inside of the right thigh of 1 c. c. of bovine culture.

November 20.—An abscess had formed, but there were no enlarged glands. The weight of the animal at the time of inoculation was 5 pounds.

December 4.—The animal was very sick and weak and could move from place to place with great difficulty. Respiration was accelerated and labored. The inguinal glands near the seat of inoculation were somewhat enlarged and the weight had decreased to 3 pounds 15 ounces.

December 11.—The animal was found dead, and autopsy showed in this case again a generalized tuberculosis.

When the cultures used were tested also upon guinea pigs, the monkeys were injected. Those receiving the bovine culture died about the same time that the rhesus that received the bovine culture died, and showed generalized tuberculosis. The guinea pigs that received the human culture are alive at the present time, but show the presence of disease. The material used for injection was prepared by shaking up a liquid culture of the germ and then drawing the liquid into a syringe, thus, of course, securing only very finely divided germs which could pass through a small needle.

These experiments, taken in conjunction with the many cases already noted in which accidental infection with tuberculosis in man can undoubtedly be traced to the bovine germ, are further evidence of the greater virulence rather than the decreased virulence of the bovine germ for man.

We have also thought it well to try again the effect of tuberculin made from bovine cultures upon tuberculous cattle and also on man. We selected animals which on previous injections had shown a characteristic reaction with the tuberculin obtained from human cultures. These same animals injected with tuberculin prepared in exactly the same method as that used in the preparation of tuberculin from human cultures, the same-sized doses being used, showed as equally characteristic reactions as if the animals had been tested with the ordinary tuberculin. Some cases in man in which the presence of tuberculosis was undoubted were also tested for us at several of the hospitals in this city. The reactions corresponded to those which are obtained when tuberculin from human tuberculosis cultures is used. In this direction again, therefore, there would seem to be no difference between the human and bovine tuberculin. We have also had tested some animals with tuberculin prepared from cultures of the horse, hog, dog, and avian tubercle bacilli. These germs had been grown upon exactly the same sort of media as that used for the preparation of tuberculin from the human and bovine germs. Exactly the same method of preparing the tuberculin was followed in all cases, and the product obtained was diluted in the same way. The injection with the tuberculin prepared from the hog and dog germs gave a characteristic reaction upon animals that had a number of months before responded to the tests with the tuberculin obtained from human cultures. The tuberculin from the avian cultures did not produce a marked reaction, although a slight one was noted, while that from the horse tubercle germ produced no reaction. These latter tests with tuberculin, however, can be regarded as preliminary only, and the failure of the horse tuberculin to produce a reaction may perhaps be attributed to the fact that the disease in the animal tested had been arrested.

These preliminary results are published now for the purpose of showing that experiments point to a greater virulence of the bovine tubercle bacilli for man rather than a decreased virulence. As will be seen later in a publication from this Bureau, the apparent morphologic differences between the human and bovine bacilli when grown upon artificial culture media are not greater than the morphologic differences seen in the bovine bacilli obtained from the different organs of the same animal.

Lartigau has well described the great variation in the virulence of human tubercle bacilli derived from man, depending on the character of the tuberculosis. The variations and morphologic differences noted are no greater than those which would be naturally noticed in any plant that has become accustomed to changed conditions.

RESULTS OF THE WORK AGAINST SHEEP SCAB IN 1901.

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AND

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In the last annual report of the Bureau there was printed an article[a] giving a general review of the work which had been inaugurated looking toward the eradication of scab. For the details of the development of this work the reader is referred to the article in question.

In that article the important point was brought out that, notwithstanding the fact that a single dipping is almost universally acknowledged as not to be relied upon as a cure for scab, the single dipping as conducted at our regular stations, and as reported in replies from 753 persons, was effective in 86 per cent of all the cases, or in flocks containing 444,665 sheep out of 515,112 sheep reported upon.

It was further shown that the results of the treatment with the three dips selected varied so greatly at the different stations that it was clear that the work at the stations was not uniform. Tobacco-and-sulphur was reported as 100 per cent effective at three stations; lime-and-sulphur was 100 per cent effective at two stations; and nicotine-and-sulphur was 100 per cent effective at one station.

The Bureau now has the statistics for the period of January 1, 1901, to December 31, 1901, inclusive. During this period flocks were inspected which aggregated 10,103,806 sheep. Of these, flocks containing a total of 9,345,289 sheep were reported as free from scab, while flocks aggregating 758,517 sheep were reported as infected. Thus flocks containing 92.4 per cent of the sheep inspected were free from scab, while flocks containing 7.5 per cent of the sheep inspected were found to have the disease.

The total number of sheep dipped in 1901 was 886,645, as compared with 934,431 dipped in 1900, thus showing a decrease of 47,786 animals treated.

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[a] D. E. Salmon, 1901. The work against scab <17th Annual Report, Bureau of Animal Industry, U. S. Dept. Agric., pp. 69–86.

The statistics for the various States and Territories in question may be seen from the following table:

Number of sheep inspected for scabies and the number dipped during the year ended December 31, 1901.

State.	Number inspected.			Number dipped.			
	Free.	Infected.	Total.	Infected.	Exposed.	Precautionary.	Total.
Arizona	103,345	13,150	116,495	5,960	....	....	5,960
California	256,732	38,000	294,732	22,300	....	....	22,300
Colorado	1,056,281	92,572	1,148,853	41,593	197	3,500	45,290
Idaho	775,083	18,100	793,183	13,097	....	....	13,097
Illinois	1,356,056	96,228	1,452,284	6,273	25,304	252,684	284,261
Indiana	5,789	600	6,389	....	....	....	....
Iowa	32,386	9,789	42,175	2,614	....	3,109	5,723
Kansas	70,322	17,951	88,273	7,590	73	....	7,663
Kentucky	3,836	....	3,836	....	53	1,711	1,764
Minnesota	166,835	5,459	172,294	4,502	22	1,135	5,659
Missouri	227,545	43,915	271,460	6,806	4,104	45,412	56,322
Montana	568,267	....	568,267	....	....	....	....
Nebraska	1,892,508	72,634	1,965,142	24,777	3,083	140,365	168,225
Nevada	358,583	108,912	467,495	41,755	50,390	4,000	96,145
New Mexico	344,876	60,820	405,696	34,312	54	....	34,366
New York	28,669	1,588	30,257	316	74	28,595	28,985
North Dakota	167,728	10,287	178,015	4,000	....	....	4,000
Ohio	78,345	5,509	83,854	1,626	1,506	8,180	11,312
Oklahoma and Indian Territory	12,711	....	12,711	....	....	....	....
Oregon	325,288	32,406	357,694	14,407	9,525	....	23,932
Pennsylvania	....	571	571	....	....	....	....
South Dakota	15,277	....	15,277	....	....	....	....
Texas	163,843	1,822	165,665	422	....	3,359	3,781
Utah	468,686	82,202	550,888	35,601	418	....	36,019
Washington	105,333	497	105,830	50	....	....	50
Wisconsin	17,000	....	17,000	....	....	....	....
Wyoming	743,965	45,505	789,470	24,568	7,223	....	31,791
Total	9,345,289	758,517	10,103,806	292,569	102,026	492,050	886,645

In 1900 South Omaha received scabby flocks aggregating 52,026 head, Kansas City 49,089, and Chicago 38,573 head, making for these three stock yards a total of 139,688 of the 264,874 scabby sheep dipped. In 1901 the Chicago figures fell to 391, the Kansas City figures fell to 6,664, and the South Omaha figures fell to 9,712, making for these three stock yards a total of 16,767, as compared with 139,668 sheep for the year 1900.

These figures are very significant, for they show how effective the system has been in preventing the extensive shipment of scabby sheep and thus lessening the danger of its being spread by railway trains.

The details regarding the number of sheep dipped at ten of the regular stations may be seen from the following table:

Statement showing the number of sheep dipped and kind of dip used at regular stations, January 1 to December 31, 1901.

Where dipped.	Kind of dip used.	Infected.	Exposed.	Precautionary.	Total.
Buffalo	Tobacco and sulphur			4,721	4,721
	Lime and sulphur	316	74	23,874	24,264
Total		316	74	28,595	28,985
Chicago	Nicotine and sulphur	391		232,568	232,969
Cincinnati	Tobacco and sulphur	1,626	1,506	8,180	11,312
Kansas City	Nicotine and sulphur	370		3,082	3,452
	Tobacco and sulphur	56	882	1,164	2,102
	Lime and sulphur	6,238	2,323	37,633	46,194
Total		6,664	3,205	41,879	51,748
Louisville	Tobacco and sulphur		53	1,711	1,764
National Stock Yards	Nicotine and sulphur	260	461	20,116	20,837
Sioux City	Tobacco and sulphur	114		3,109	3,223
South Omaha	Tobacco and sulphur	9,712	249	136,686	146,647
South St. Joseph	Nicotine and sulphur		897	1,857	2,754
	Tobacco and sulphur	142	2	1,676	1,820
Total		142	899	3,533	4,574
South St. Paul	Tobacco and sulphur	3,731	22	1,135	4,888
Total by dips	Nicotine and sulphur	1,021	1,358	257,623	260,002
	Tobacco and sulphur	15,381	2,714	158,382	176,477
	Lime and sulphur	6,554	2,397	61,507	70,458
Grand total		22,956	6,469	477,512	506,937

The same three dips used in 1900 were used in 1901. Of 506,937 sheep dipped at ten regular stations, 260,002 animals, or 51.2 per cent, were treated with nicotine and sulphur; 176,477 sheep, or 34.8 per cent, were treated with tobacco and sulphur; and 70,458 sheep, or 13.9 per cent, were treated with lime and sulphur.

While these figures are interesting, one would not be justified in concluding that they necessarily represent, in the minds of the owners or agents, the relative values of the dips, for while at certain stations, such as Kansas City, the owners or their agents can select any one of the three dips allowed, other stations keep only one or two dips on hand, hence the selection of the dip is left entirely to the company which does the dipping.

Inquiries relative to the effects of the single dipping were sent to the owners or their agents and 536 replies were received. From these it appears that the dipping was effective in flocks aggregating 326,967 sheep, and ineffective in flocks aggregating 29,392 sheep. Thus, so far as replies have been received, the single dipping was successful in 91.8 per cent of the cases, as compared with 86 per cent for the year

1900, and ineffective in 8.2 per cent, as compared with 14 per cent in 1900. The statistics for 1900 were based upon 753 replies and covered flocks aggregating 515,112 sheep.

It will be noticed that the statistics for 1901 are based upon 530,286 sheep less than were dipped during the previous year.

In the report for 1900 attention was called, as stated above, to the fact that the effectiveness of the three dips varied in different stations. The same point is noticed for the dipping during 1901. Thus the reports of sheep dipped at five stations (or States) indicate 100 per cent effectiveness for lime and sulphur; at one station 98 per cent; at one station the reports vary from 84 to 96 per cent; and at one station the report gives 0 per cent. For tobacco and sulphur the dipping at four stations was reported as 100 per cent effective; at one station the dipping varied between 83 and 100 per cent; at one station it averaged 73 and at another 69 per cent. For nicotine and sulphur the dippings at three stations (or States) resulted in 100 per cent effectiveness; at one station it varied between 91 and 100 per cent; at one it varied between 91 and 96 per cent; and at one it varied between 0 and 72 per cent.

Kansas City is the only station for which reports exist for all three dips. This station shows a marked improvement over the work of 1900, for reports on its work give 100 per cent effectiveness for both nicotine and sulphur and tobacco and sulphur, and 84 to 96 per cent effectiveness for lime and sulphur. This station averaged in 1900 only 64 per cent for nicotine and sulphur, 72 per cent for tobacco and sulphur, and 67 per cent for lime and sulphur. The great improvement in the figures for 1901 supports the contention that it is fully as necessary to use a dip properly as it is to determine upon what dip shall be used.

In giving these figures it is only fair that special attention should be directed to the fact that these statistics include not only infected flocks, but also those which were exposed to infection and those which were dipped as a precautionary measure.

The details for the various stations may be seen from the accompanying table.

Statement showing the efficacy of dips used on sheep exposed to and infected with scab, January 1 to December 31, 1901, compiled from 536 replies to circular letter of January 30, 1902, sent to purchasers.

Where dipped.	Nicotine and sulphur.				Tobacco and sulphur.				Lime and sulphur.				Totals.				
	Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		Grand total.
	Number.	Per cent.	Number.	Per cent	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.
Buffalo					2,401	100			11,201	98	220	2	13,602	98.4	*220*	*1.6*	13,822
Chicago	[a] *14,609* 102,135	*96* 91	*600* 9,541	*4* 9									116,744	92	*10,141*	*8*	126,885
Cincinnati					*423* 3,073	*83* 100	*84*	*17*					3,496	97.7	*84*	*2.3*	3,580
Kansas City	1,121	100			*1,167* 240	*100* 100			*4,336* 20,105	*84* 96	*837* 1,243	*16* 4	26,969	92.8	*2,080*	*7.2*	29,049
National Stock Yards	*1,711* 8,453	*100* 91	880	9									10,164	92	*880*	*8*	11,044
South Omaha					*26,350* 59,231	*71* 95	*10,684* 3,238	*29* 5					85,581	86	*13,922*	*14*	99,503
South St. Joseph	787	72	*450* 300	*100* 28	467	73	170	27					1,254	57.7	*920*	*42.3*	2,174
Louisville					282	69	130	31					282	69	*130*	*31*	412
Sioux City					*85*	*100*							85	100			85
South St. Paul					*1,000*	*100*							1,000	100			1,000
Seligman, Ariz											*115*	*100*			*115*	*100*	115
Stockdale, Ill											*900*	*100*			*900*	*100*	900
Shelton, Nebr									*6,000*	*100*			6,000	100			6,000
North Platte, Nebr									*4,000*	*100*			4,000	100			4,000
Nevada									*13,100* 4,000	*100* 100			17,100	100			17,100
New Mexico									*8,690*	*100*			8,690	100			8,690
Utah	*5,000*	*100*											5,000	100			5,000
Wyoming	*12,000*	*100*							*15,000*	*100*			27,000	100			27,000
Total	145,816	92.5	11,771	7.5	94,719	87	14,306	13	86,432	96	3,315	4	326,967	91.8	*29,392*	*8.2*	356,359

[a] Infected sheep shown in italic figures.

Comparing the totals for 1900 and 1901, we obtain the statistics given in the following table:

Dips.	1900.				1901.				Totals 1900-1901.			
	Number of sheep.		Per cent.		Number of sheep.		Per cent.		Number of sheep.		Per cent.	
	Effective.	Ineffective.	Effective.	Ineffective.	Effective.	Ineffective.	Effective.	Ineffective.	Effective.	Ineffective.	Effective.	Ineffective.
Nicotine and sulphur	190,307	23,655	88	12	145,816	11,771	92.5	7.5	336,123	35,426	90.47	9.53
Tobacco and sulphur	183,361	21,609	89	11	94,719	14,306	87	13	278,080	35,915	88.56	11.44
Lime and sulphur	70,997	25,183	74	26	86,432	3,315	96	4	157,429	28,498	84.67	15.33
Totals for the three dips	444,665	70,447	86.32	13.68	326,967	29,392	94.56	5.44	771,632	99,839	88.54	11.46

From this table it will be seen that in effectiveness—

(1) Nicotine and sulphur stands second in 1900, second in 1901, but first for the two years combined.

(2) Tobacco and sulphur stands first in 1900, third in 1901, and second for the two years combined.

(3) Lime and sulphur stands third for 1900 (when it made the lowest record of any dip during the two years), first for 1901 (when it made the highest record of any dip for the two years), and third for the two years combined.

The results of the two years' dipping fully confirm the position taken by the Bureau in 1898, and there is no reason for altering the opinions as expressed at that time. The three dips selected have been proved to be equally effective in a large number of cases. We must, in fact, confess that, considering the fact that the statistics are based upon a single-dipping treatment, the results exceed our expectations.

So far as curative powers are concerned, we have no preference to express in regard to the three mixtures. From practical considerations, the advice given in 1898 is repeated:

> The homemade dips, which are most commonly used, have either tobacco or sulphur as their basis, while the prepared dips contain tobacco, sulphur, arsenic, carbolic acid, etc., as curative agents.
>
> In selecting a dip several points should be considered: First of all, the question of expense will naturally arise; next, the question as to whether or not scab actually exists in the flock, or whether or not the dipping is more of a precautionary matter, or for the sake of cleansing the animal's skin. The facilities at hand, the setback to the sheep, and the length of the wool are also matters for consideration, as well as the pastures into which the dipped sheep are to be placed. Notwithstanding statements to the effect that a given dip can be used under all conditions, the above questions are evidently important.
>
> *Expense.*—In estimating the expense one should consider not only the actual outlay for the ingredients of the ooze, but the cost of fuel and labor, the injury, if any, to the sheep, and the liability of not curing the disease. It is much more economical to use an expensive dip and cure scab than it is to use a cheap dip and fail to

cure it. To illustrate with a well-known homemade dip: A lime-and-sulphur dip may be made in ten to thirty minutes, with but little fuel and little labor, which may or may not cure the disease, and which will surely do great injury to the wool; or a lime-and-sulphur dip may be made in several hours' time, at the expense of considerable fuel, labor, and patience, which can be relied upon to cure scab, and which will do little or no injury to the wool. The first dip is cheap, but not economical; the second is more expensive, but more economical.

Does scab exist in the flock?—Every farmer should ask himself this question before he selects his dip. If scab does not actually exist and the wool is long, the dipping in this case simply being a matter of precaution, it is best not to select a dip containing lime. The use of the lime-and-sulphur dips is therefore not advised simply as precautionary dressing for healthy long-wooled sheep. On the contrary, the use of any dip containing lime, as a precautionary measure, should be avoided.

The facilities at hand for preparing dip.—If fuel is very scarce, so that it is impracticable to boil the mixture for at least two hours, the lime-and-sulphur dips should not be selected.

A tobacco-and-sulphur[a] dip, as well as many of the better proprietary dips, can be made without the necessity of lengthy boiling, and should be given preference whenever facilities for boiling are not at hand. * * *

The pastures.—In case it is necessary to place the dipped sheep on the same pastures they occupied prior to treatment it is always best to use a mixture containing sulphur. If a proprietary dip is selected under those circumstances it is suggested that sulphur be added, about 1 pound of flowers of sulphur to every 6 gallons of dip. In case it is possible to utilize fresh pastures after dipping, the use of sulphur is not so necessary, but is always advisable. The object in using sulphur is to place in the wool a material which will not evaporate quickly, but will remain there for a longer period of time than the scab parasites ordinarily remain alive away from their hosts. By doing this the sheep are protected against reinfection. * * *

By all means the use of a tobacco dip, or of the tobacco-and-sulphur dip in preference to the lime-and-sulphur dips, is advised in case the sheep to be dipped show no unmistakable signs of scab.

The advantages of the tobacco dip are that it is comparatively cheap, since the farmer can grow his own tobacco; that it is effectual, and at the same time not injurious to the wool. The disadvantages of the dip are that it sometimes sickens the sheep; that it also occasionally sickens the persons who use it, especially if they are not smokers; it spoils very rapidly; it causes a greater setback than lime and sulphur, but less of a setback than carbolic dips. * * *

To summarize the position of the Department on the lime-and-sulphur dips: When properly made and properly used, these dips are second to none, and equaled by few as scab eradicators. There is always some injury to the wool resulting from the use of these dips, but when properly made and properly used upon shorn sheep it is believed that this injury is so slight that it need not be considered; on long wool the injury is greater and seems to vary with different wools, being greater on a fine than on a coarse wool. This injury consists chiefly in a change in the microscopic structure of the fiber, caused by the caustic action of the ooze. When improperly made and improperly used the lime-and-sulphur dips are both injurious and dangerous, and in these cases the cheapness of the ingredients does not justify their use. In case scab exists in a flock and the farmer wishes to eradicate it, he can not choose a dip which will bring about a more thorough cure than will lime and sulphur (properly made and properly used), although it will be perfectly possible for the farmer to find several other dips which will, when properly used, be nearly or equally as effectual as any lime-and-sulphur dip. There is no dip to which objections can not be raised.

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[a] Tobacco was used in the report quoted to cover both the nicotine and the tobacco dips.

CONTAGIOUS DISEASES OF ANIMALS IN FOREIGN COUNTRIES.

GREAT BRITAIN.

FOOT-AND-MOUTH DISEASE.

Dr. Alex. C. Cope, chief veterinary officer of the Board of Agriculture of Great Britain, says in his report for 1900:

> The most important event in connection with the duties of the veterinary department during the year 1900, from the stock owners' point of view, has undoubtedly been the reintroduction into this country of foot-and-mouth disease, which occurred in the month of January and continued to break out sporadically at irregular intervals during the whole of the year.

The last previous outbreak occurred in 1894, when, as at the present time, an order was in force which prohibited the importation of animals from every country in Europe. During the year 1900 there were 21 outbreaks, and 214 cattle, 50 sheep, and 2 hogs were attacked.

The authorities were unable to trace these outbreaks to the point and time of introduction into Great Britain, but it is shown that foot-and-mouth disease was present in many cattle which arrived from Argentina. Dr. Cope says: "No cases of foot-and-mouth disease were detected in foreign animals landed in this country from the year 1889 until the second week in April of 1900, at which date the steamship *Ethelhilda* arrived at Deptford from Buenos Ayres, having on board 244 cattle and 1,107 sheep. Of these, no fewer than 154 cattle were found to be affected with foot-and-mouth disease on landing, 2 head of cattle and 35 sheep having been lost at sea." Dr. Cope further states that within a period of six weeks 24 cargoes of diseased animals arrived at Deptford and 3 at Liverpool, and the serious effect of the disease was shown in an instance where 289 cattle were shipped and only 6 landed alive in England. In several other cargoes the losses exceeded half the number originally put on board.

These 27 vessels took into England 3,793 cattle and 29,742 sheep, of which 1,561 cattle and 4,014 sheep were found to be diseased after landing. Besides these, 2,737 cattle and 1,871 sheep were lost at sea.

CONTAGIOUS PLEUROPNEUMONIA.

Several suspected cases of contagious pleuropneumonia were reported, but an investigation showed that the pneumonia was not contagious pleuropneumonia. It is stated by Dr. Cope that "the country has, therefore, been free for two years."

RABIES.

Outbreaks of rabies were confined to three counties in the south (mountainous districts) of Wales, where the disease was confirmed in 6 dogs, 4 cattle, and 1 horse. Fifteen dogs which had been exposed to the contagion were killed. For the first time in fifty-two years not a person is reported to have died in 1900 of hydrophobia. It should be remembered that as late as 1877 no fewer than 79 persons died of this terrible disease. Dr. Cope says: "It may truly be said that the board has never undertaken a duty which has rendered so great a service to the community of this country, from the point of view of human health, as the extinction of rabies in the dog."

GLANDERS.

There was a marked increase in glanders during 1900 over the previous year. During 1900 the number of outbreaks was 1,109, while in 1899 the number was 826. The number of horses attacked was 1,814, or 545 more than in 1899. The increase was wholly in England. In Scotland there was a decrease in outbreaks from 27 in 1899 to 10 in 1900. No case was reported for Wales.

SWINE FEVER.

Mr. J. T. Tennant, assistant secretary of the board of agriculture, reports as follows on swine fever:

The following table shows the number of outbreaks of swine fever which have occurred each year in England, Wales, and Scotland since the year 1894, inclusive:

Number of outbreaks of swine fever in England, Wales, and Scotland, 1895 to 1900.

Country.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
England	5,123	5,818	4,721	1,958	2,154	2,041	1,816
Wales	351	334	244	117	228	175	100
Scotland	208	153	201	80	132	106	24
Total	5,682	6,305	5,166	2,155	2,514	2,322	1,940

From this table it will be seen that the total number of outbreaks of swine fever occurring during the year 1900 is the lowest since 1893, and though the reduction in the number of outbreaks in 1900 as compared with the numbers recorded for the three previous years is not very large, it must, when considered in connection with the figures for the whole period 1894 to 1900, inclusive, be regarded as a satisfactory indication that some useful progress has been made.

RUSSIAN EMPIRE.

The statistics for this Empire are from the Report of the Veterinarian Service of the Department of the interior of Russia for the year 1898, published in 1901. Of the total number of 180,917,106 domestic animals, 1,037,499 were attacked by infectious or epizootic diseases in 1898.

Table showing number of different kinds of animals diseased and dead or killed in 1898.

Kind of animal.	Diseased.	Died.	Killed.	Total loss.
Horses	90,370	31,826	11,779	43,605
Cattle	674,648	110,228	6,827	117,055
Sheep	153,329	34,620	565	35,185
Goats	1,304	111	23	134
Hogs	35,063	19,919	198	20,117
Reindeer (anthrax)	82,149	82,149	....	82,149
Camels	564	183	214	397
Cervus elaphus	14	14	....	14
Buffaloes	8	5	....	5
Total	1,037,449	279,055	19,606	298,661

Note especially the fatality of anthrax among the reindeer. The total number of 82,149 which were attacked died.

The various diseases which were prevalent there are shown in the next table; also the number of domestic animals which were attacked and the losses resulting therefrom.

Diseases of domestic animals prevailing in the Russian Empire, with total cases and number of losses, in 1898.

Name of disease.	Total cases.	Died and killed.
Foot-and-mouth disease	585,795	4,874
Anthrax	147,122	137,658
Cattle plague	95,647	79,053
Sheep pox	58,750	17,375
Scabies	72,970	1,253
Swine erysipelas	23,441	14,830
Influenza	14,749	1,995
Glanders	13,139	12,644
Contagious pleuropneumonia	10,617	6,798
Diarrhea	8,799	335
Hematuria	8,796	3,108
Swine plague	5,821	4,343
Intestinal worms	4,482	1,531
Liver fluke	4,132	3,439
Herpes	3,996	48
Rabies	3,443	....
Bleunovelesea of the eyes	2,058	22
Actinomycosis	1,410	602
White scour of calves	1,571	1,302
Lungworm disease	893	685
Tuberculosis	830	[a]580

[a] This appears to be the result of about 5,000 tests, and is acknowledged not to be complete.

Diseases of domestic animals prevailing in the Russian Empire, with total cases and number of losses, in 1898—Continued.

Name of disease.	Total cases.	Died and killed.
Gid of sheep	817	635
Malignant catarrhal fever	597	397
Angina	542	191
Stomatitis	434	4
Dysentery	424	212
Blackleg	396	371
Eczema	326	4
Contagious abortion	262	1
Diphtheritis	191	123
Pneumonia of horses	187	71
Horse typhus	155	84
Tetanus	154	123

FRANCE.

Contagious diseases among domestic animals in France during the year 1901.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Contagious pleuropneumonia:													
Number of outbreaks	13	4	5	9	4	6	4	1	.....	1	.....	3	50
Number slaughtered	36	9	17	22	7	7	7	1	.....	.....	.....	7	114
Number inoculated	21	71	.....	34	9	28	.....	.....	.....	.....	.....	.....	163
Foot-and-mouth disease (outbreaks)	4,971	3,460	3,833	2,742	2,366	3,252	3,984	4,402	3,206	2,333	1,487	1,432	37,397
Sheep scab (outbreaks)	11	12	19	34	15	41	37	3	4	2	14	13	205
Sheep pox (outbreaks)	63	35	14	17	31	47	78	170	70	63	71	72	731
Anthrax (outbreaks)	35	19	31	78	23	40	25	67	52	35	46	44	495
Blackleg (outbreaks)	32	24	31	34	53	34	56	65	58	67	66	70	590
Glanders and farcy:													
Number of outbreaks	62	52	52	53	90	68	49	54	55	54	38	65	692
Horses slaughtered	105	98	96	101	103	99	93	75	86	76	83	77	1,092
Rabies (cases)	202	241	230	272	240	254	242	242	233	192	173	197	2,718
Rouget (outbreaks)	36	5	30	25	37	33	29	44	41	46	53	25	404
Hog cholera (outbreaks)	21	14	5	12	13	23	41	25	18	14	27	17	230

Prevalence of certain contagious diseases of animals for the years 1895 to 1901.

Name of disease.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Contagious pleuropneumonia:							
Number of outbreaks	224	189	181	110	206	206	50
Number slaughtered	589	400	404	290	514	420	114
Number inoculated	1,980	1,413	1,101	786	1,183	1,395	163
Foot-and-mouth disease (outbreaks)	677	2,334	1,601	9,458	43,098	77,604	37,397
Rabies (cases)	1,692	1,687	2,073	1,781	2,374	2,771	2,718

GERMAN EMPIRE.

Number of localities and farms infected with contagious diseases of animals in the German Empire at end of each month in the year 1901.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Glanders:												
Localities	60	58	50	40	35	39	43	50	48	39	39	37
Farms	83	74	56	52	48	51	53	54	51	47	48	45
Pleuropneumonia:												
Localities	8	9	7	14	14	7	4	4	6	7	7	9
Farms	8	9	8	14	15	9	5	5	9	9	8	14
Foot-and-mouth disease:												
Localities	292	275	236	133	101	80	84	67	58	213	261	144
Farms	436	562	416	223	294	270	366	282	263	1,041	1,780	550
Hog cholera, including swine plague:												
Localities	253	391	508	555	595	606	589	577	452	423	474	449
Farms	319	533	643	773	790	792	828	776	563	511	599	572

HUNGARY.

GLANDERS.

	Cases.
1895	1,241
1896	681
1897	931
1898	1,745
1899	918
1900	900

ANTHRAX.

Kind of animal.	1897.		1898.		1899.		1900.	
	Affected.	Died.	Affected.	Died.	Affected.	Died.	Affected.	Died.
Horses	209	197	216	216	245	237	200	195
Cattle	1,889	1,739	1,888	1,865	2,053	2,011	2,285	2,195
Sheep	968	968	1,100	1,100	614	614	764	761
Total	3,066	2,904	3,204	3,181	2,912	2,862	3,249	3,151

FOOT-AND-MOUTH DISEASE.

	1895.	1896.	1897.	1898.	1899.	1900.
Cattle affected	282,282	572,809	70,491	28,832	19,947	8,225
Sheep affected	25,620	178,612	25,450	3,806	1,538	13,195
Hogs affected	59,940	82,931	3,758	1,011	345	7,189
Total	367,842	834,352	99,699	33,649	21,830	28,609

PLEUROPNEUMONIA.

	1896.	1897.	1898.	1899.	1900.
Died and slaughtered as affected	313	262	390	10	19
Slaughtered as suspicious	781	735	254	95	67
Exposed (sent to slaughterhouse)	7,563	4,580	2,289	577	521
Total	8,657	5,577	2,933	682	606

HOG CHOLERA AND SWINE PLAGUE.

	1896.	1897.	1898.	1899.	1900.
Hogs attacked	868,777	514,291	318,030	327,716	271,689
Hogs died of the disease	639,765	360,838	206,445	199,151	168,746
Hogs killed	13,093	5,201	2,827	4,618	2,757
Farm premises reported	....	84,828	40,951	40,967	36,174

RED MURRAIN OF SWINE.

Hogs affected	28,806	11,068	7,624	19,213	21,419
Farm premises reported	....	2,764	1,748	4,648	4,365

SCAB.

	1895.	1896.	1897.	1898.	1899.	1900.
Horses affected	2,500	1,713	970	949	1,695	1,918
Cattle affected	32	119	4	....	....	....
Sheep affected	4,003	4,156	3,222	6,483	1,856	6,134

SHEEP POX.

Sheep affected	2,274	938	9,536	5,401	5,129	3,470
Sheep died	265	254	1,526	569	488	253
Farm premises affected	....	....	292	239	229	44

BLISTER UPON GENITALS.

Horses affected	79	118	81	137	264	154
Cattle affected	338	217	134	492	587	207
Counties reported	....	15	16	19	41	31
Farm premises reported	....	238	143	433	544	230

RABIES.

Dogs	1,227	1,274	1,282	1,219	1,125	1,157
Cats	....	....	....	4	11	2
Horses	13	14	22	11	12	9
Cattle	60	74	120	35	68	27
Sheep	1	8	40	7	5	9
Hogs	....	63	53	51	50	52
Donkey	....	....	....	....	1	1
Goat	....	....	....	....	....	1

BUFFALO CHOLERA.

Cases reported	206	350	99	313	299	297
Farm premises reported	....	153	69	105	101	153

FOOTHALT.

This disease was first reported in 1898, when there were 71 cases. There were no cases in 1899, but in 1900 two outbreaks are reported, one horse being affected in each case.

ITALY.

Cases of contagious diseases of domestic animals in Italy during the year 1901.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.
Cattle plague						
Contagious pleuropneumonia						
Anthrax	73	82	128	102	203	187
Blackleg	8	10	15	22	16	13
Foot-and-mouth disease	932	4,350	16,566	14,620	21,832	41,181
Tuberculosis						4
Glanders and farcy	25	30	39	38	48	31
Sheep pox		75	106	1	18	5
Rabies	17	29	21	23	34	57
Sheep scab	6,907	1,554	3,527	8,463	13,309	5,342
Maladie du coït				1	13	
Hog cholera and swine plague	377	318	322	1,200	2,605	2,840
Barbone of buffalo					5	30
"Agalassia contagiosa" (of sheep and goats)		230	105	443	1,593	3,333

Name of disease.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Cattle plague							
Contagious pleuropneumonia							
Anthrax	187	299	541	175	415	108	2,500
Blackleg	21	24	53	15	1,024	40	1,261
Foot-and-mouth disease	83,655	42,891	17,792	9,362	11,409	9,806	274,396
Tuberculosis	26	35	21	14	17	19	136
Glanders and farcy	49	39	48	41	38	45	471
Sheep pox	205	220	189				819
Rabies	29	33	34	28	46	14	365
Sheep scab	10,253	3,779	845	2,120	2,983	508	59,590
Maladie du coït							14
Hog cholera and swine plague	3,845	1,890	1,215	1,017	1,079	510	17,218
Barbone of buffalo	40	10		12		2	99
"Agalassia contagiosa" (of sheep and goats)	3,367	476	359	198	90		10,194

SWITZERLAND.

Cases of contagious diseases among domestic animals in Switzerland during the year 1901.

Month.	Contagious pleuropneumonia.	Blackleg (died and slaughtered).	Anthrax (died and slaughtered).	Foot-and-mouth disease (affected and suspected).	Rabies (died and slaughtered).
January		17	19	442	2
February		9	19	525	
March		6	14	809	
April		15	21	289	
May		25	17	193	
June		80	18	119	
July		190	18	1,994	
August		172	28	2,374	
September		109	13	331	
October		63	19	639	
November		25	11	99	
December		8	13	296	1
Total		719	210	8,110	3

Cases of contagious diseases among domestic animals in Switzerland, etc.—Continued.

Month.	Glanders and farcy.		Rouget.		Sheep scab (affected and suspected).	Tuberculosis
	Died and slaughtered.	Suspected.	Died and slaughtered.	Affected and suspected.		
January	8	....	100	245	....	....
February	2	5	66	165	187	....
March	6	2	79	311	6	25
April	1	....	88	812	27	16
May	9	18	172	397	....	3
June	6	11	207	448	....	....
July	7	....	405	699	....	1
August	5	10	853	844	663	....
September	2	1	270	570	....	....
October	5	3	344	777	72	....
November	4	2	112	116	....	7
December	6	19	98	211	6	11
Total	61	71	2,289	5,095	961	63

AUSTRIA.

Number of farms infected with contagious diseases of animals in Austria at end of each month during the year 1901.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Foot-and-mouth disease	116	58	30	106	88	72	26	85	162	7	......	14
Anthrax	4	4	11	11	5	22	59	51	57	16	12	2
Contagious pleuropneumonia	......	......	......	......	......	......	......	......	......	......	......	......
Glanders and farcy	8	8	7	9	10	12	14	17	20	7	5	8
Sheep pox	76	70	85	32	18	16	14	39	43	45	41	28
Scab	9	18	37	88	72	71	95	72	21	19	35	28
Blackleg	......	......	......	......	......	1	18	4	1	5	......	......
Red murrain of swine	167	54	38	48	117	130	294	332	132	147	121	11
Swine plague	434	384	276	227	374	399	735	945	618	818	536	190
Blister upon genitals	21	54	117	103	190	184	126	71	7	36	14	15
Rabies	24	17	28	19	30	28	16	40	22	21	34	25

NETHERLANDS.

Cases of contagious diseases of animals in the Netherlands for the year 1901.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Cattle plague	......	......	......	......	......	......	......	......	......	......	......	......	......
Contagious pleuropneumonia	......	......	......	......	......	......	......	......	......	......	......	......	......
Foot-and-mouth disease	1,113	.....	624	225	......	912	2,364	3,814	6,909	4,184	911	.....	[a]21,056
Glanders and farcy	4	.....	10	5	......	8	8	....	1	2	1	.....	[a]39
Sheep scab	108	.....	47	8	......	473	591	620	846	454	163	.....	[a]3,310
Sheep pox	......	......	......	......	......	......	......	......	......	......	......	......	......
Foot rot of sheep	81	.....	13	31	......	81	123	81	27	31	32	.....	[a]500
Rouget	12	.....	5	9	......	50	362	770	216	146	49	.....	[a]1,619
Trichinosis of swine	......	......	......	......	......	......	......	......	......	......	......	......	......
Anthrax	22	.....	19	21	......	36	20	34	16	8	19	.....	[a]195
Rabies	......	......	......	......	......	......	......	......	......	......	......	......	......

[a] Total for nine months.

BELGIUM.

Cases of contagious diseases of domestic animals in Belgium for the year 1901.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Glanders and farcy	2	3	2	2	3	4	2	2	......	1	1	3	25
Contagious pleuropneumonia	......	......	......	......	......	......	......	......	......	......	......	......	......
Foot-and-mouth disease	971	969	968	749	590	433	480	604	512	296	245	303	7,120
Rabies	1	......	......	2	1	3	1	8	3	2	......	2	23
Anthrax	64	54	64	64	70	73	83	98	87	89	93	60	899
Foot rot	87	......	26	......	......	......	1	5	......	4	......	9	132
Sheep scab	2	......	......	......	......	......	......	......	......	......	......	......	2
Tuberculosis	1,624	1,409	1,550	1,439	1,575	1,375	1,231	1,525	1,564	1,630	1,502	1,502	17,926
Tuberculosis, 1900	......	......	......	......	......	......	......	......	......	......	......	......	17,679
Tuberculosis, 1899	......	......	......	......	......	......	......	......	......	......	......	......	15,067

DENMARK.

Number of outbreaks of contagious diseases among domestic animals in Denmark for the year 1901.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Anthrax	11	3	11	11	8	2	4	4	1	5	3	6	69
Foot-and-mouth disease	1	......	......	......	......	......	......	......	......	......	......	......	1
Sheep pox	......	......	......	......	......	......	......	......	......	......	......	......	......
Foot rot of sheep	......	......	......	......	......	......	2	......	......	......	......	......	2
Sheep scab	......	......	......	......	......	......	......	......	......	......	......	......	......
Cerebro-spinal meningitis	6	3	2	7	6	2	......	1	2	4	2	3	38
Glanders	......	......	......	......	......	......	......	......	......	......	1	......	1
Malignant catarrhal fever	4	3	7	9	4	12	8	6	6	6	4	2	71
Contagious pleuropneumonia	......	......	......	......	......	......	......	......	......	......	......	......	......
Cattle plague	......	......	......	......	......	......	......	......	......	......	......	......	......
Hog cholera or swine plague	6	12	6	3	1	3	......	4	3	4	2	......	44
Rouget:													
Acute	30	5	16	28	29	48	56	35	20	40	40	16	363
Chronic	17	2	6	3	7	2	7	7	19	21	23	17	131
Nodular erythema	50	24	69	57	72	167	325	381	333	544	336	119	2,477

NORWAY.

Cases of contagious diseases of domestic animals reported in Norway for the year 1901.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Cattle plague	......	......	......	......	......	......	......	......	......	......	......	......	......
Contagious pleuro-pneumonia	......	......	......	......	......	......	......	......	......	......	......	......	......
Foot-and-mouth disease	......	......	......	......	......	......	......	......	......	......	......	......	......
Rabies	......	......	......	......	......	......	......	......	......	......	......	......	......
Sheep pox	......	......	......	......	......	......	......	......	......	......	......	......	......
Glanders	......	......	......	......	......	......	......	......	......	......	......	......	......
Anthrax	30	47	66	48	51	35	49	28	34	21	20	38	467
Blackleg	1	1	1	2	2	2	7	5	3	3	5	......	32
Braxy	11	5	3	7	......	......	1	......	......	16	17	7	67
Malignant catarrhal fever	10	27	31	23	30	22	30	15	17	17	24	27	273
Sheep scab	......	......	......	......	......	......	......	......	......	......	......	......	......
Rouget	28	29	32	30	49	70	140	117	232	239	194	58	1,218
Hog cholera	22	1	13	......	1	......	1	......	3	......	......	......	41
Foot rot of sheep	......	......	......	......	......	......	......	......	......	......	......	......	......

SWEDEN.

Outbreaks of contagious diseases of domestic animals in Sweden for the year 1901.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Cattle plague	......	......	......	......	......	......	......	......	......	......	......	......	......
Contagious pleuro-pneumonia	......	......	......	......	......	......	......	......	......	......	......	......	......
Glanders and farcy	......	......	......	......	......	......	1	......	......	......	......	......	1
Anthrax	12	17	12	10	22	15	27	12	13	18	11	10	179
Emphysema infectiosum	2	4	2	13	4	2	6	7	5	3	1	1	50
Sheep pox	......	......	......	......	......	......	......	......	......	......	......	......	......
Foot-and-mouth disease	......	......	......	......	......	......	......	......	......	......	......	......	......
Sheep scab	......	......	......	......	......	......	......	......	......	......	......	......	......
Foot rot	......	......	......	......	......	......	......	......	......	......	......	......	......
Rabies	......	......	......	......	......	......	......	......	......	......	......	......	......
Swine diphtheria	......	......	......	......	......	......	......	......	......	......	......	......	......

MISCELLANEOUS INFORMATION.

The horse trade of the United States with foreign countries.—Not many years ago the impression was quite prevalent throughout the civilized world that an era was approaching when the usefulness of the horse would be greatly curtailed. Extremists went so far even as to forecast a "horseless age." That there were grounds for these predictions, inasmuch as other motive forces were at that time rapidly supplanting animal power, is obvious. In cities, the traction power formerly supplied entirely by horses was giving way, first, to the cable car and, later, to the electric street railway. Afterwards the bicycle and then the automobile gave promise that the application of the principles embodied in these inventions might entirely eliminate the horse from many other phases of urban life. In the country, too, the portable engine, the steam plow, and many economies in the use of animal power suggested the probability of the eventual substitution of mechanical power, to a large extent, for horse power on the farm.

It is apparent now that these gloomy predictions as to the future utility of the horse fell short of fulfillment, having been made on the very eve of a period when Great Britain would have to pay one of the largest bills for horse supplies that was ever paid for such supplies by any nation at any time in the world's history, and when both the horse and mule trade of the United States with foreign countries was to assume a magnitude unprecedented in the history of this Republic.

The present activity, however, of the foreign trade of the United States in horses and mules really dates back to the panic of 1893. The low prices, largely the result of the panic, at which good horses might then be had in this country doubtless had much to do with attracting the attention of foreign buyers to the exceptional advantages of the United States as a source of horse supplies. The result was immediately reflected in the export trade. Exports of horses and mules combined, which in 1893 had amounted to only 4,601 head, valued at less than a million dollars, increased by leaps and bounds until in 1898 they reached the total of 59,248 head, worth $6,841,358. In the following year the outbreak of the war in South Africa gave an additional impetus to this trade in all exporting countries, especially in the United States, Mexico, Argentina, and Australasia; exports from the United States quickly responded to the increased demand, and in the fiscal year ended June 30, 1900, they amounted to a total of 108,091 head, horses and mules combined, valued at $11,532,094. In the succeeding fiscal year they increased further to the high-record mark of 116,655 head, with a value of $12,089,112.

The statistics of the foreign trade of the United States in horses, stated separately, present some very interesting features. The trade naturally divides itself into two periods, the line of demarcation being the year 1894. The first period, extending from 1884, when horses were first separately specified in statements of imports, up to 1894, is characterized by a heavy, though declining, excess of imports over exports, the imports for the entire period averaging annually 42,318 head, against average annual exports of only 2,670 head. The second period, extending from 1895 up to the present time, is, on the contrary, notable for a phenomenal excess of exports over imports, the average annual exports amounting for the period to 46,077 head, against average annual imports of only 6,157. The following statement shows the exports and imports of horses separately for the full period for which figures on imports are available:

United States exports and imports of horses.

Year ended June 30—	Exports.		Imports.	
	Number.	Value.	Number.	Value.
1884	2,721	$424,317	45,610	$3,726,584
1885	1,947	377,692	39,985	3,292,298
1886	1,616	348,323	58,903	4,312,576
1887	1,611	351,607	56,395	4,872,982
1888	2,263	412,744	62,401	5,405,873
1889	3,748	592,469	58,714	4,868,862
1890	3,501	680,410	49,116	4,840,485
1891	3,110	784,908	22,537	3,265,254
1892	3,226	611,188	14,074	2,455,868
1893	2,967	718,607	15,451	2,388,267
1894	5,246	1,108,995	6,166	1,319,572
1895	13,984	2,209,298	13,098	1,055,191
1896	25,126	3,530,703	9,991	662,591
1897	39,532	4,769,265	6,998	464,808
1898	51,150	6,176,569	3,085	414,899
1899	45,778	5,444,342	3,042	551,050
1900	64,722	7,612,616	3,102	596,592
1901	82,250	8,878,845	3,785	985,738

The foreign trade of the United States in mules is entirely an export one. Previous to 1894 the foreign demand for these animals was not greatly inferior to, in fact, in some years it was in excess of, the foreign demand for United States horses. This trade, like that in horses, began to improve, though not in such heavy proportions, as a result of panic prices, and the recognized value of mules in the army transport service, afterwards, upon the outbreak of the South African war, created an extraordinary demand. The following statement shows the total exports of mules from the United States, and, separately, the total exports of horses and mules combined for each year during the past decade:

United States exports of mules, and of mules and horses combined.

Year ended June 30—	Exports of mules.		Exports of horses and mules.	
	Number.	Value.	Number.	Value.
1892	1,965	$238,591	5,191	$849,779
1893	1,634	210,278	4,601	928,885
1894	2,063	240,961	7,309	1,349,956
1895	2,515	186,452	16,499	2,395,750
1896	5,918	406,161	31,044	3,936,864
1897	7,473	545,331	47,005	5,314,596
1898	8,098	664,789	59,248	6,841,358
1899	6,755	516,908	52,533	5,961,250
1900	43,369	3,919,478	108,091	11,532,094
1901	34,405	3,210,267	116,655	12,089,112

Until the outbreak of the war in South Africa the United States export trade in horses was practically confined to two channels: First, the European trade, monopolized almost entirely by the United Kingdom, Germany, and Belgium; and, second, what may be called the North American trade, consisting of exports to countries of the North American continent and its outlying islands. The trade with the rest of the world was unimportant. Until after 1894 the North American trade absorbed the lion's share of our exports. But in the following year a European demand sprang up which increased exports to Europe from 7,972 head in 1895 to 37,377 head in 1900, while the North American trade, the bulk of which was with British North America, increased during the same period from only 5,850 head to 14,045. During this same period, it is true, exports to all the rest of the world increased from 162 head in 1895 to 13,300 head in 1900, but this heavy increase was due almost entirely to shipments of 10,220 head to South Africa and an initial shipment of 2,437 head to the Philippines in the latter year. A more comprehensive idea of the recent development of the United States export trade in horses may probably be obtained from the accompanying statement, which gives separately the exports to Europe, to North American countries and outlying islands, to South Africa, and to all other countries combined from 1894 to 1901.

Exports of horses from the United States.

Year ended June 30	To Europe.	To North America.	To South Africa.	To all other countries.
	Number.	*Number.*	*Number.*	*Number.*
1894	1,452	3,653	0	141
1895	7,972	5,850	1	161
1896	17,243	7,690	1	192
1897	28,488	10,508	1	535
1898	37,673	12,989	117	371
1899	31,949	12,890	127	812
1900	37,377	14,045	10,220	3,080
1901	24,488	14,842	37,465	5,455

It is thus seen that the extraordinarily heavy exports of horses from the United States in 1901, amounting as they did to 82,250 head, were due primarily to shipments of 37,465 head to South Africa—a larger number of horses, with one exception, than had ever been consigned up to that time to any single destination in the history of our country. If this factor, however, be entirely eliminated from the trade, there is still apparent a remarkable and almost steadily increasing demand in both North American and European countries for horses bred and reared in the United States.

The export trade of the United States in mules has been confined, with the exception of shipments in recent years to South Africa, to Hawaii, and to the Philippines, almost exclusively to countries and islands on this side of the Atlantic. Previous to 1900 the Central American States, Mexico, and the West Indies took annually from 65 to 75 per cent of our entire exports, Mexico and Cuba in the latter years being by all odds the most important customers. In 1900, however, although the trade with Central America, Mexico, and the West Indies, as a whole, almost doubled in numbers, the proportion which it formed of the aggregate export trade declined to less than 20 per cent, the decline in proportion being due entirely to shipments in that year of 31,014 head to South Africa, 1,260 head to Hawaii, and 1,703 head to the Philippines. It is notable that in the following year the total shipments of mules from the United States were 8,964 head less than in 1900, whereas exports of horses showed an increase of 17,528 head over the year previous. But from the fact that exports of mules with reference to countries of destination have not yet been separately stated in reports of the Treasury Department, the cause of this opposite movement between the trade in mules and that in horses is not apparent.

The activity in both the foreign horse and mule trade of the United States continues up to the present time, the former showing further remarkable increases, the latter some tendency to decline. In the eight months ending February 28 of the fiscal year 1901–2 the total exports of horses amounted to 71,438 head, against 51,856 head for the corresponding months of the previous fiscal year, the exports to South Africa aggregating 46,844 head, against 21,342 head, respectively, for the eight-month periods. Exports of mules for the first eight months of the fiscal year 1901–2 aggregated 20,698 head, against 27,595 head for the corresponding period of the year previous. The total exports of horses and mules for the first eight months of the current fiscal year have amounted to 92,136 head, valued at $9,098,863.—*Statistician, Department of Agriculture.*

Sheep feeding in Nebraska.—A very slight study of the geography of the United States, as well as the agricultural productions of the various States, shows Nebraska to occupy the position, as it were, of the gateway between the corn-raising States and the range or stock-raising States. The eastern portion of Nebraska, say for 200 miles west of the Missouri River, may be said to be purely agricultural—given to the raising of food stuffs, corn, wheat, alfalfa, and hay—while the western portion of the State is more devoted to range purposes. This is why Nebraska is often referred to as the "gateway"—on account of its geographical position as well as its diversity of soil and climate. Then, too, the State has within its borders the third largest packing center in the United States, and, it might be added, in the known world, namely, Omaha. St. Joseph, Mo., and Kansas City, Mo., also lie in close proximity, so that feeders and shippers in Nebraska are enabled to load their stock into cars and have them on any of these markets the following morning.

The bulk of the sheep and lambs fed in this State are brought from Utah, Oregon, Idaho, and Wyoming, and are shipped in in lots ranging from two carloads to a train load. Most feeders try to buy their stock of sheep for feeding during the months of October and November, and then start them on feed as soon as possible.

For the first week or two they "fill" on alfalfa or sugar cane, then gradually get them on a grain ration of corn, at first only giving half a pound per head per day; but in a month they are on full feed, which means 1½ to 2 pounds for lambs and 2 to 2½ pounds for sheep.

On this ration, along with good alfalfa or hay, sheep will be fat and ready for market in sixty to ninety days, while lambs require a longer feed, say four to five months. In this time they will have gained from 20 to 35 pounds, owing to the proficiency of the feeder who has them in charge. Men of experience agree that sheep require more attention in feeding than any other animal. Just a fraction too much of a grain ration will throw them off their feed for several days, then there is no gain, but rather a loss.

The profits and loss depend solely upon the price paid for the stock, the cost of feeding, the amount of gain in weight, and the price obtained. As a rule lambs are put into the feed yards at a cost of $2 to $2.50 per head, and sheep at $3 to $3.50 per head. In order to make a fair profit on the investment and labor, the feeder should receive at least $5 per 100 pounds, live weight, for sheep and $6 per 100 pounds for lambs.

The climate of the State is such that feeders do not consider it necessary nor profitable to build sheds or barns for sheltering the feeding sheep, but wherever there is natural protection in the way of timber it is utilized. The sheep are inclosed in pens to suit the feeder, say 500 to 700 in a pen, and remain there from the time they arrive until shipped to market. Each pen has an abundant and never-failing supply of good water.

Crop conditions, of course, control the number of sheep and lambs fed in the State. The number fed annually ranges from 200,000 to 800,000.

The sheep-scab mite and low temperature.—Dr. A. A. Holcombe, a veterinary inspector of the Bureau of Animal Industry, forwarded the following letter from Aurora, Ill. It has a special bearing upon the ability of sheep-scab mites to withstand very low temperatures:

SIR: Assuming that any evidence bearing upon the question as to whether the measures of disinfection, enforced last season at the several feeding stations, have been effective in destroying the infection of scabies will be of interest, I beg to report the following facts: On November 11, 1901, Mr. Nicholas Bonson, Grand Island, Nebr., unloaded at Stockdale 2,100 sheep and lambs, which, according to the owner, had not been dipped. They have not been dipped since reaching Stockdale. On November 14 they were placed in the west barn, which had not been used since it was given a second coat of lime and carbolic, a few days before.

The pens in which these sheep (not the lambs) were placed had been occupied late last season by the C. L. Buell sheep, from Martell, Nebr. The Buell sheep were thoroughly infected with scab, and were held in these pens nearly a month before they were sheared and dipped. I therefore think it may safely be assumed that these pens were the most thoroughly infected of all the pens at this station.

Bonson has marketed all but 160 of his sheep, and these are free from all signs of scab at the expiration of one hundred and three days after entering the pen.

In trying some experiments in order to determine how tenacious of life the scab mite is, I find that in every experiment but one 1 or more of the mites will live beyond one hundred and fifty-two hours, dating from the time they are removed from the host. The only exception was with mites from a very poor lamb, and they all succumbed inside of seventy-two hours.

I find further that the mite will withstand a low temperature without any apparent ill effect. I subjected 19 to a temperature of 10° F. for two hours, and yet on warming the glass plates to 105° they were as lively as ever and starved at the period between one hundred and fifty-two and one hundred and sixty-four hours.

Another wisp of wool from the same sheep containing 9 mites was placed out in a temperature of 17° F. and held for six hours and twenty minutes, during which time the temperature fell to 8° F. The mites were apparently hard frozen and lifeless, yet on raising the temperature to 105° F. only 1 had succumbed. At the end of one hundred and fifty-two hours 2 were yet alive, but all were dead at one hundred and sixty hours.

I am curious to know how much cold it takes to kill them and whether they will live an indefinite time if kept frozen. The weather, however, is too warm for determining this point at this time, although I have some mites that have been out six days.

Does freezing prevent the mite eggs from hatching?

Work of the Bureau of Animal Industry indorsed.—The following resolutions were unanimously adopted by the fifth annual convention of the National Live Stock Association, held in Chicago, Ill., December 3–6, inclusive, 1901:

Whereas there has lately developed such opposition in some quarters to the efforts of the Bureau of Animal Industry to prevent the spread of bovine tuberculosis in this country by rigid inspection and tests applied to imported cattle, especially where they are imported for breeding purposes; and

Whereas the opposition has attempted to make use of the argument lately advanced that bovine tuberculosis is not the same disease as that which afflicts the human race and is not communicable to man as a reason why the rigid inspection and condemnation of diseased animals should cease; and

Whereas the disease known as bovine tuberculosis is communicable and infectious among cattle, produces fatal results, and is a disease to be feared and kept out if possible; and

Whereas the stockmen of this country are particularly anxious that their breeding stock should be physically healthy, and object to contagious disease among their cattle in any form, whether it is dangerous and communicable to man or not: Therefore,

Resolved by the National Live Stock Association in convention assembled, That we most heartily indorse the work of the Bureau of Animal Industry in striving to limit and eradicate this disease from the herds of the United States; and we insist that, while the enforcement of quarantine and inspection rules may work hardship and loss upon the individual, it is simply a case where private interests must become subservient to the public welfare.

Resolved, That the officers of this association be authorized to give all the support possible to the efforts of the Government in fighting this disease, and we assure the Bureau of Animal Industry that it will receive the support of this association in all legitimate efforts to eradicate this dread disease from the live stock of this country.

Jno. W. Springer, *President.*
C. F. Martin, *Secretary.*

Live stock in Russian Empire.—The official statement of live stock in the Russian Empire for 1898 is shown below:

Horses	28,473,891
Cattle	46,352,914
Buffaloes	401,552
Mules	92,754
Asses	144,139
Camels	1,305,472
Reindeer	269,499
Sheep	84,849,677
Goats	3,604,608
Hogs	15,422,600

Imports of cattle and sheep by Great Britain.—The following tables, copied from the report for 1900 of Mr. J. T. Tennant, assistant secretary of the Board of Agriculture of Great Britain, shows, by countries, the number of cattle and sheep imported by Great Britian, and the number lost in transit, for the three years 1900, 1899, and 1898:

CATTLE.

Countries from which received.	1900.		1899.		1898.	
	Imported.	Lost.	Imported.	Lost.	Imported.	Lost.
Canada	104,839	834	94,660	586	108,405	264
United States	350,209	1,072	321,229	1,390	369,478	748
Argentina	38,562	4,096	85,365	3,757	89,369	5,271
Channel Islands	1,826	1	1,732		1,814	
Uruguay	209	1	518	2		
Total	495,645	6,004	503,504	5,735	569,066	6,283

SHEEP.

Canada	35,673	363	63,930	625	42,070	938
United States	142,906	1,384	121,030	2,710	147,021	1,496
Argentina	178,969	5,348	382,080	9,545	430,073	16,395
Chile			13,602	510	4,304	352
Iceland	24,217	1,942	22,650	951	28,086	120
Falkland Islands					12,193	577
Uruguay	1,068	32	4,463	167		
Total	382,833	9,069	607,755	14,508	663,747	19,878

Wool exports from Montevideo.—Consul Swalm reports the following from Montevideo, November 11, 1901:

The wool exports of Montevideo for the year ended October 31, 1901, were as follows, in bales of 500 kilograms (1,102 pounds) each:

To—	1899-1900.	1900-1901.
Antwerp	18,819	16,880
Dunkirk	16,194	31,828
Havre	319	498
Bremen	2,558	7,207
Hamburg	6,552	17,415
Genoa	983	720
New York	436	756
Liverpool	5,576	7,187
Total	51,437	84,491

The shearing has just commenced for this year's clip, and the general outlook is promising. It is estimated that there will be an exportable balance of 100,000 bales.—(*Consular Report, February, 1902.*)

Arabian wool trade.—Consul-General Hughes reports from Coburg, September 24, 1901, that, according to the German press, the wool from the neighborhood of Bagdad is considered the best in Arabia, the next is from the region around Mosul, and then from Kurdistan.

Wool is the most important export from Mesopotamia, and its chief point of shipment is Bagdad. Bassorah exported, in 1899, 37,650 bales of wool of a value of 6,024,000 francs ($1,162,623) as against 38,000 bales in 1898. All of this went to Great Britain, France, and the United States. Not one modern factory for woolen goods exists in Arabia, in spite of its large quantities of the raw material. The only use of the wool is the making of abas (a large outer garment) by hand.

Egg industry in Denmark.—In a previous communication we spoke of dairying and pork production in Denmark, and showed how that little country had advanced to first place, all things considered, in their important lines. The latest effort in agricultural advancement in Denmark has been along the line of egg production. In Copenhagen we visited an egg-exporting house where scores of hands were busy sorting eggs into four grades, according to size, and packing them into attractive form for shipment to Great Britain and other countries. At Hasley we visited one of the sources of supply. Our little party visited the farm of Viggo Ulrick, a few miles from the village. The good wife, who spoke English fluently, in the husband's absence showed us the place and explained the farm operations. Two hundred milch cows were kept. But our interest was in the poultry department. There were 1,500 hens and 1,600 chickens. She told us they were members of the egg syndicate. There are all sorts of farmer organizations or combinations in Germany, France, and Denmark, operating under the term "syndicate." Each day as the eggs are gathered they were marked with the date, syndicate number, and membership number in the syndicate by the aid of a rubber stamp and aniline ink. Three or four times a week the eggs so marked were taken to the village syndicate quarters, there to be packed and shipped to headquarters at Copenhagen. At Copenhagen the eggs are carefully examined and prepared for shipment. If a stale egg is found, the local syndicate is immediately notified of that fact, together with the date stamped on the egg. The fine for each bad egg sent to Copenhagen is a sum equal to about $1 of our money, the same to be paid by the member turning it into the local syndicate.

We asked if this fine was enforced, and were informed that such was the case. We inquired what happened when eggs of doubtful quality were found on the farm, as must sometimes occur. We were told that these were broken at home and used if good, or sold to the village store with proper explanation. Great care was exercised not to send a doubtful egg to Copenhagen.

If one continues careless after fines and warning, he is expelled from the syndicate. The prices paid by the syndicate for eggs are announced each Monday morning from Copenhagen and notice sent to all the local syndicates. This particular farm, we were informed, cooperating with the Agricultural College of Copenhagen, was about to conduct experiments to determine the relative merits of purebred and common fowls for the production of eggs. A representative of the college was to conduct the work in person. We have already spoken of the fact that the farmers of Denmark practiced cooperation or combination of effort in the production of butter; also, that through the combined effort or syndicates, they owned pork-packing establishments and produced bacon products, selling at high prices in Great Britain. We have now learned that even the eggs of Denmark are largely produced and handled by syndicates of farmers or farmers' unions. The people have learned the economy and advantages of combined effort. In 1898 Denmark exported over $3,600,000 worth of eggs. This was an increase of 80 per cent in five years. The same year the United States imported $8,000 worth of eggs, and exported $450,000 worth.—(*H. Henry, in the Breeders' Gazette.*)

Eggs in Spain.—Spain imported, during 1896, 24,402,183 eggs, principally from Morocco and Portugal, and exported 6,920,983, principally to Great Britain. Galicia, in the northern part of Spain, is the only exporting province. The southern provinces are the chief importers. Nowhere in Spain can the production of eggs be very large, for they sell for 2 pesetas a dozen when fresh and for 1½ pesetas when more than four days old (a peseta now is equivalent to about 15 cents gold). Recently a poultry farm was started in Arenys de Mar, near Barcelona, and 10,000 chickens are annually raised there, and from 1,500 to 2,000 fowls of superior breeds are kept for sale.

Egg production.—In his report on the trade of Cherbourg, the British consul says that the export of eggs from that port has been considerably affected by the importation of eggs into the United Kingdom from Egypt, no less than 60,000,000 eggs, to the value of £83,034, being exported from Egypt during the first six months of 1900. In the year 1899 the eggs exported from Egypt amounted to the value of £44,000. To this cause is mainly due the decrease in the export of eggs from Cherbourg, amounting to a diminution of 298 tons since 1897.

Russian exports are increasing steadily, the shipments in 1899 amounting to 1,800,000,000 eggs, representing a value of more than $15,000,000, says the American Agriculturist. To stimulate this business the Russian Government is admitting free of duty packing cases for the export of eggs; this concession to last for five years.

It is asserted that New Yorkers eat 2,160,000 eggs daily, and although the United States produce 10,000,000,000,000 eggs yearly, this does not supply the demand, and Canada, Spain, Italy, and even China have to help them to fill the demand. The imported eggs amount to 15,000,000 dozen yearly.—(*Agricultural Journal, October 24, 1901.*)

Milk flour in Sweden.—Dr. M. Ekenberg, of Gothenburg, has made a discovery which will be of importance in dairy farming. He claims to have invented an apparatus by which milk can be brought into the form of powder, like flour in appearance, but possessing all the qualities of milk in concentrated form, moisture excepted. It is said that this milk in flour is completely soluble in water, and can be used for all purposes for which common milk is employed. The milk flour does not sour, does not ferment, and in the dry state is not sensitive to changes in the weather. It can be kept and transported in tin cans, barrels, bags, etc. The cost of production Dr. Ekenberg has estimated at about 27 cents per 106 quarts, and he thinks that flour made from skimmed milk can be sold for about 13 cents per pound. At a recent meeting of the Academy of Agriculture, Dr. Ekenberg exhibited samples of the milk flour, which received favorable comments. It is considered that the invention will be of the greatest importance for the utilization of skimmed milk, which heretofore has largely been wasted, but in the dry form can be transported all over the country without losing any of its original qualities.

The product mentioned is considered superior to the casein products "proton" and "proteide," now manufactured from milk by the aid of rennet, acid, or lye.—(*Robert S. S. Bergh, Consul at Gothenburg, November 20, 1901.*)

IMPORTS AND EXPORTS OF ANIMALS AND ANIMAL PRODUCTS.

By John Roberts,
Editorial Office, Bureau of Animal Industry.

EXPORTS.

According to the report of the Bureau of Statistics of the Treasury Department, the total value of the exports of domestic merchandise for the calendar year 1901 amounted to $1,438,083,990. The exports of foreign merchandise for the same period were valued at $27,296,929; thus the exports from all sources reached the total of $1,465,380,919.

As the purpose here is to deal more particularly with domestic products, the figures used hereafter will refer to these only and will not take into account the exports of foreign goods.

The totals for 1901 quoted above are a little below those of the previous year. Domestic exports then reached the large total of $1,453,010,112, which sum exceeds the figures of last year by $14,926,122. However, this small deficit is not of so much importance when it is considered that 1900 was a phenomenal year. The gain of that year over 1899 was upwards of $200,000,000; it is sufficiently satisfactory, therefore, not to have gone back farther.

A comparison of the value of animals and animal products sent abroad in 1901 with that of all other products and manufactures shows the former in a very favorable light. As compared with 1900, the exports of domestic products other than animal products fell off to the extent of $38,885,910, whereas those of animal origin made the substantial gain of $23,959,788.

The following statement gives the exports of animal products for the past ten years, with the amount of gain or loss, respectively, in each year:

Value of exports of animals and animal products for the years 1892–1901.

Year.	Value of exports.	Gain (+) or loss (−).	Year.	Value of exports.	Gain (+) or loss (−).
1892	$224,531,279		1897	$214,400,463	−$2,647,949
1893	196,243,366	−$28,288,913	1898	237,952,127	+23,551,664
1894	215,462,956	+ 19,219,590	1899	256,285,487	+18,332,350
1895	219,492,191	+ 4,029,135	1900	271,826,854	+15,541,367
1896	217,048,412	− 2,443,779	1901	295,786,642	+23,959,788

It should be stated that the above figures include not only the principal animal products, such as animals and meat and dairy products, but also all other products which are unquestionably of animal origin—including leather and boots and shoes; bones, hoofs, horns, horn tips, etc.; candles, eggs, feathers, and glue; grease, hair, and hair manufactures, and hides and skins (other than furs); lard oil, oleo oil, stearin; and wool, both raw and manufactured.

IMPORTS.

The value of the imports of animals and animal products for 1901 amounted in the aggregate to $113,186,057. This is in the neighborhood of $3,000,000 less than the total for the previous year. It may be noted, on the other hand, that 1900 and 1899 both showed considerable increases.

The list of articles imported which follows shows there are three items only which we are compelled to buy in large quantities. The most important of these is hides and skins (other than furs), for which we paid in 1901 the large sum of $55,565,388. We purchased wool and wool manufactures to the value of $29,621,964; and we required $11,375,939 worth of leather and leather manufactures to supply our wants. These three items represent 85 per cent of the entire imports of animal products.

The table which follows shows that hides and skins continue on the increase, rather more than $4,000,000 being paid in 1901 in excess of the previous year. The two other items above mentioned decreased appreciably—leather and leather manufactures by $1,922,998, and wool and wool manufactures by $5,394,188.

Of the smaller items on the list, cattle, eggs, glue, grease and oils, and meat products remain practically the same as in 1900. A considerable increase is noted in horses, feathers, and dairy products. The remainder, consisting of sheep, bones, hoofs, etc., bristles, hair, hide cuttings and glue stock, and sausage casings, show a decrease in every case, but none to any remarkable extent.

Following is an itemized statement (p. 613) showing in comparative form for the past four years the annual value of the animals and animal products imported by the United States from foreign countries.

Table showing the value of imports of animals and animal products for the years 1898–1901.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Articles imported.	1898.	1899.	1900.	1901.
Horses	$521,835	$581,928	$886,811	$1,266,709
Cattle	2,730,882	2,235,373	1,871,546	1,942,605
Sheep	1,187,210	1,305,063	1,260,132	990,299
All other, including fowls	242,080	282,383	138,649	379,975
Bones, hoofs, horns, etc	784,360	988,502	1,031,725	893,537
Bristles	1,245,591	1,871,010	1,995,289	1,666,747
Eggs	6,531	24,628	7,862	12,041
Feathers, etc	4,649,479	4,719,756	1,461,308	2,001,498
Glue	445,019	528,765	491,190	449,769
Grease and oils	380,665	575,668	475,815	471,014
Grease	243,742	245,710	198,136	395,682
Hair	1,829,112	2,477,332	2,065,002	1,867,472
Hides and skins	39,906,373	51,127,659	51,590,433	55,565,388
Hide cuttings and glue stock	290,500	1,068,273	1,186,627	826,206
Leather and leather manufactures	11,346,815	11,894,318	13,298,937	11,375,939
Meat products	285,611	505,552	452,669	474,232
Dairy products	1,807,065	2,271,764	2,010,164	2,401,485
Sausage casings	560,943	622,544	738,529	583,495
Wool and wool manufactures	26,794,324	26,256,772	35,016,152	29,621,964
Total	95,258,137	109,583,000	116,176,976	113,186,057

IMPORTS AND EXPORTS OF FARM ANIMALS.

The two tables which follow show this branch of our trade from different points of view. The first gives the annual status for the past six years, showing the growth, or otherwise, during this period. The other shows in detail our exports for the year 1901, together with the country of destination.

The trade in cattle continues to be in a very healthy condition. The number exported in 1901 was 454,590, as against 423,181 in 1900, an increase of 31,409. This is the largest number exported in the past decade and probably in the history of the trade. While it is satisfactory to note this increase in number, it is still more so to note the increase in value which has occurred in the past three years. The 409,176 cattle exported in 1899 were worth $30,685,461, or $75 per head. The valuation of the 423,181 sent abroad in 1900 was placed at $33,819,164—an equivalent of $79 per head. The figures in 1901 were 454,590 and the value $36,606,204, which is equal to $81 per head. The total increase last year amounted to 31,409 head in number and $2,787,040 in value.

The great bulk of our export trade in animals is with Great Britain, as will be seen by a glance at the second table. Our trade with the other countries on the list, excepting, perhaps, the West Indies and Canada, is quite insignificant.

In this connection it may be opportune to call attention to the efforts

Number and value of imports and exports of farm animals for the years 1896 to 1901.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Year.	Cattle.		Hogs.		Horses.		Mules.		Sheep.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
EXPORTS.		*Dollars.*		*Dollars.*		*Dollars.*		*Dollars.*		*Dollars.*
1896	394,772	36,576,412	33,785	367,917	28,632	3,601,137	6,534	475,106	323,576	1,948,841
1897	447,469	39,379,532	16,841	150,814	45,642	5,617,265	7,753	631,904	218,427	1,331,712
1898	397,879	33,463,267	16,879	117,546	48,917	6,010,773	6,996	514,569	176,498	1,070,966
1899	409,176	30,685,461	52,230	363,609	49,983	5,747,468	20,228	1,702,099	150,824	861,337
1900	423,181	33,819,164	33,915	313,836	79,520	9,102,432	50,179	4,757,892	148,391	900,734
1901	454,590	36,606,204	15,909	169,097	99,809	10,037,204	25,053	2,267,262	432,419	2,514,766
IMPORTS.										
1896	141,653	988,677	....	....	8,252	509,819	....	....	382,443	1,013,481
1897	403,717	3,581,643	....	....	5,993	505,838	....	....	414,455	1,145,922
1898	261,826	2,730,882	....	....	2,718	321,835	....	....	360,820	1,187,210
1899	186,596	2,235,383	....	....	3,215	581,928	....	....	361,731	1,305,063
1900	142,055	1,871,546	....	....	3,541	886,811	....	....	345,985	1,260,132
1901	135,694	1,942,605	....	....	4,402	1,266,709	....	....	265,952	990,299

Number and value of exports of farm animals for the calendar year 1901 and countries to which exported.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Country to which exported.	Number.	Value.
Cattle:		
United Kingdom	361,107	$34,040,140
Other Europe	230	23,000
British North America	17,963	843,075
Central American States and British Honduras	243	11,660
Mexico	3,080	171,280
West Indies and Bermuda	71,583	1,484,352
South America	285	24,452
Asia and Oceania	47	2,785
Other countries	52	5,460
Total	454,590	36,606,204
Hogs:		
British North America	2,178	15,785
Mexico	3,657	45,276
West Indies and Bermuda	9,996	106,649
South America	35	890
Asia and Oceania	4	200
Other countries	39	297
Total	15,909	169,097
Horses:		
United Kingdom	18,377	2,711,195
Germany	553	86,900
Other Europe	711	72,500
British North America	14,323	1,097,580
Central American States and British Honduras	84	13,412
Mexico	2,641	114,576
West Indies and Bermuda	3,932	253,916
South America	61	13,850

Number and value of exports of farm animals for the calendar year 1901 and countries to which exported—Continued.

Country to which exported.	Number.	Value.
Horses—Continued.		
Asia and Oceania	31	$22,450
Africa	59,096	5,650,795
Total	99,809	10,037,204
Mules	25,053	2,267,262
Sheep:		
United Kingdom	262,222	1,984,868
Other Europe	640	5,120
British North America	162,002	450,558
Mexico	1,507	14,339
West Indies and Bermuda	4,933	33,605
South America	895	7,717
Other countries	220	18,559
Total	432,419	2,514,766
All other, including fowls	....	231,411

EXPORTS TO THE UNITED KINGDOM.

Our trade in animal products with the United Kingdom continues on the increase year by year. The large and increasing proportions it has assumed may be seen from the totals of the exports to that country for the past four years, which are as follows:

1898	$149,039,783
1899	155,555,299
1900	163,821,666
1901	181,397,723

The increase in 1901 was much greater than in any other year in this period, amounting to $17,576,057.

The principal items contained in the exports of 1901, in their order of magnitude and with the values of each, were: Cattle, $34,040,140; bacon, $32,473,650; fresh beef, $31,899,293; hams, $22,251,238; and lard, $18,207,569.

Each one of these products shows a substantial advance on the year previous. The two most noteworthy instances being hams, which increased from $18,242,651 to $22,251,238, and lard, which was valued at $18,207,559, as against $14,244,979 in 1900. The gain in each case being, in round numbers, $4,000,000.

The smaller items on the list all show a uniform advance, with the following few exceptions. The number of horses shipped was 10,585 less than in 1900, representing a decrease in value of $1,651,357. This falling off is no doubt accountable, as was the shrinkage of the horse trade with South Africa, to a lessening of the demand for animals for war purposes.

Tallow fell off about 50 per cent. The amount purchased in 1901 was valued at $1,015,143, as against $2,026,362 worth shipped in 1900.

An examination of the business in dairy products shows a peculiar state of affairs. Butter made a greater gain, proportionately, than anything on the list, advancing from 7,092,512 pounds, valued at $1,311,588, in 1900, to 17,146,985 pounds, valued at $3,046,395, in 1901. On the other hand, cheese dropped in an equally abrupt manner, falling in quantity from 49,924,492 to 29,179,866 pounds, and in value from $5,084,459 to $2,740,947. However, a comparison between these two years alone may be apt to give a wrong impression, which a glance further back will prove. The value of the exports of 1898 was $2,139,905 and of 1899 $2,797,035; it is therefore apparent that for some reason the trade of 1900 was phenomenally large. If we eliminate that year and compare 1901 with 1898 and 1899, it will be found to be quite satisfactory.

Quantity and value of animals and animal products purchased by the United Kingdom from the United States in the years 1900 and 1901.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article.	1900.		1901.	
	Quantity.	Value.	Quantity.	Value.
	Number.	*Dollars.*	*Number.*	*Dollars.*
Cattle	335,020	31,414,083	361,107	34,040,140
Hogs	....	....	....	....
Horses	28,962	4,362,552	18,377	2,711,195
Sheep	96,672	729,710	262,222	1,984,868
	Pounds.		*Pounds.*	
Hides and skins (other than furs)	153,744	16,092	170,823	17,331
Sole leather	26,924,895	4,960,378	31,528,017	5,545,181
Other leather	....	9,533,691	....	9,812,092
Boots and shoes	....	1,094,672	....	1,847,187
Canned beef	34,123,691	3,326,442	40,675,302	3,986,155
Fresh beef	322,860,648	28,943,559	350,624,203	31,899,293
Other beef	21,047,769	1,277,138	18,112,375	1,110,603
Tallow	40,535,458	2,026,362	20,234,636	1,015,143
Bacon	376,137,577	30,275,054	363,736,542	32,473,650
Hams	170,559,938	18,242,651	206,318,614	22,251,238
Pork	85,470,352	6,241,112	96,455,139	7,969,423
Lard	205,491,297	14,244,979	212,448,743	18,207,569
Oleo oil and oleomargarine	10,002,294	737,144	8,535,927	739,313
Butter	7,092,512	1,311,588	17,146,985	3,046,395
Cheese	49,924,492	5,084,459	29,179,866	2,740,947
Total	....	163,821,666	....	181,397,723

EXPORTS TO GERMANY.

Compared with the total of the preceding year, our trade in animal products with Germany made considerable progress in 1901, notwithstanding the decline in some important products, due to the discouragement and restrictive legislation of the German authorities. The increase mentioned, however, does not make the volume of trade as large as it was four years ago.

The total value of the exports of 1901 was $23,143,539, which, contrasted with 1900, is an increase of $3,253,645. All of this increase, and more besides, is taken up by the chief article on the list, lard. This product constitutes fully two-thirds of the entire exports. The amount of it taken in 1901 was 186,136,934 pounds, the value being $15,861,432, which is an increase over the previous year of 11,687,862 pounds, and in value $4,048,293.

The article second in importance is oleo and oleomargarine, of which 32,760,779 pounds was purchased, valued at $2,645,105. This is a gain of $266,775 on the value exported in 1900.

Bacon, which is the third largest export, has been on the down grade for the past four years, although the decrease in 1901, as compared with 1900, was very slight.

Boots and shoes continue to gain rapidly. The amount purchased in 1901 was valued at $201,599, which is $59,570 greater than the total of 1900.

Slight gains are noticed in hams and pork, but the totals, especially that of the former, are much below those of four years ago.

Butter, which had dwindled to the small amount of $18,390 in 1900, rose to $86,462, which brings it somewhere near the normal point of the past few years.

The trade in horses and beef shows a large falling off. The number of horses exported in 1901 was only 553, as against 2,637 in 1900; but it should be remembered that our surplus for the past two or three years has been nearly all taken by Great Britain for shipment to South Africa. Canned and other beef in 1901 was valued at $508,913, while in 1900 the amount was $809,420.

Germany imports considerable quantities of animals and animal products. When it is borne in mind that she purchases the following annually, to the approximate value of the amount placed against each, it would seem as if our breeders and packers ought to get a larger share of the trade:

Horses	[a] $20,000,000
Cattle	6,000,000
Beef	15,000,000

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[a] Taken from Commercial Relations for 1900, issued from the Bureau of Foreign Commerce, Department of State. The figures here quoted are for the year 1899, none later being available.

Quantity and value of animals and animal products purchased by Germany from the United States in 1900 and 1901.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article.	1900.		1901.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
Horses....number..	2,637	410,215	553	86,900
Hides and skins (other than furs)	4,577,370	388,224	4,435,960	333,660
Sole leather	218,083	47,857	38,865	7,307
Other leather	....	851,703	....	676,901
Boots and shoes	....	142,029	....	201,599
Canned beef	4,207,011	405,127	400,887	38,360
Other beef	6,953,010	404,293	7,642,475	470,553
Tallow	13,240,782	658,900	6,292,070	337,088
Bacon	19,946,653	1,513,383	19,031,622	1,492,586
Hams	2,435,065	230,255	2,409,370	254,646
Pork	10,338,611	628,035	8,488,825	650,400
Lard	174,449,072	11,813,139	186,136,934	15,861,432
Oleo and oleomargarine	30,541,719	2,378,330	32,760,779	2,645,105
Butter	109,353	18,390	552,714	86,462
Cheese	64	14	5,295	540
Total	....	19,889,894	....	23,143,539

EXPORTS TO FRANCE.

Our trade in animal products with the French Republic is not very extensive. The entire business done in 1901 amounted to only $2,224,297. This is a falling off to the extent of $1,207,668 from the total for 1900, the amount for that year being $3,431,965.

The items on the list which shrank most were bacon, from $494,066 to $155,969; hams, from $174,118 to $31,454; tallow, from $557,945 to $290,459; and lard, from $1,461,487 to $974,374. Beef products and pork declined in a lesser degree.

A few others, however, showed improvement over the figures of 1900. Particularly may be mentioned leather and boots and shoes, the trade in which, though not large, is in a flourishing condition. Exports of leather in 1901 rose to $547,064, against $472,826 for the previous year, and boots and shoes increased from $82,446 to $121.573.

Hides and skins advanced from $13,976 to $20,964.

Quantity and value of animals and animal products purchased by France from the United States in 1900 and 1901.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article.	1900.		1901.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
Horses ....number..	10	17,575	....	....
Hides and skins (other than furs)............	94,140	13,976	178,007	20,364
Leather....................................	....	472,826	....	547,064
Boots and shoes	....	82,446	....	121,573
Canned beef.................................	1,175,776	118,842	674,588	67,448
Other beef..................................	559,100	31,913	148,890	7,097
Tallow......................................	11,207,072	557,945	5,560,246	290,459
Bacon	7,464,961	494,066	1,960,196	155,909
Hams..	1,754,585	174,118	320,856	31,654
Pork	111,725	6,771	91,800	7,295
Lard	21,660,779	1,461,487	12,060,253	974,374
Total	....	3,431,965	....	2,224,297

EGGS.

The increasing volume which has characterized the export trade in eggs for the past few years was not maintained in 1901. Whereas over $1,000,000 worth was sent out of the country in 1900, the value fell to $619,956 in the past year. This amount, however, excepting as noted above, has only once before been exceeded, namely, in 1899; and it is at any rate satisfactory to note that when a comparison is made between the imports and exports of 1901 it will be seen that the balance of trade remains very noticeably in our favor.

Below is a statement showing the imports and exports of eggs annually for the past ten years. It will be noticed that for the first half of this period the imports largely exceeded the exports, and that during the last five years the exact reverse was the case. This was brought about owing to the stimulating effect of a change in the tariff. During the first period eggs were admitted free; but when the duty was placed upon them the home trade received such an impetus that it was enabled to supply the domestic consumption and export several million dozens annually as well.

Imports and exports of eggs from 1892 to 1901.

Year.	Imports.		Exports.	
	Quantity.	Value,	Quantity.	Value.
	Dozens.	*Dollars.*	*Dozens.*	*Dollars.*
1892	3,373,086	379,516	193,742	34,851
1893	2,457,576	284,178	151,311	43,098
1894	1,641,901	190,437	174,523	28,258
1895	1,954,962	219,459	181,754	29,346
1896	677,359	56,004	405,192	63,460
1897	190,674	9,259	2,734,218	424,819
1898	129,711	6,581	2,356,474	394,982
1899	259,106	24,628	4,595,994	816,855
1900	117,596	7,862	5,937,032	1,000,139
1901	162,918	12,041	3,419,198	619,956

EXPORTS OF MEAT AND DAIRY PRODUCTS.

We continue to supply the world with an increasing quantity of beef products every year. Our canned beef went, as usual, to all quarters of the globe. The total amount exported in 1901 was 53,239,582 pounds, valued at $5,233,782. This is an advance over the previous year in quantity of 1,323,837 pounds, and in value of $83,769. The price per pound in the last two years remained about the same; it was, however, considerably higher than the price obtained in 1899. The two largest consumers of canned beef in the past year were the United Kingdom and Africa. The greater portion of the total, or 40,675,302 pounds, of the value of $3,986,155, went to the former, and the latter received 6,969,760 pounds, valued at $659,037. France and Germany and other Europe bought less than in 1900, particularly Germany. The amount purchased by that country in 1900 was 4,207,011 pounds; value, $405,127. In 1901 it fell to the small total of 400,887 pounds; value, $38,360.

Fresh beef, as will be seen from the table which follows, has made rapid advances in the past few years. The quantity sent abroad in 1901 was 354,421,731 pounds, which was worth $32,294,877. This exceeded the business of 1900 by 28,065,144 pounds, and brought in $2,987,099 more. This trade is practically all with Great Britain; as much as 99 per cent was taken last year by that country. Of the rest, West Indies and Bermuda took $379,470 worth.

Salted, pickled, and other cured beef is, like the canned article, distributed over a wide area. The business in these products fell off somewhat in 1901, the deficit chiefly occurring in the exports to Great Britain, which took about 3,000,000 pounds less than in 1900. Of the total value exported last year, amounting to $3,099,492, Great Britain purchased $1,110,603; Germany $470,553, a gain over 1900 of $66,260; other Europe $450,522, a gain of $66,678; West Indies and Bermuda

$331,192, a slight gain; and British North America $321,063, a gain of $36,821. The remainder is made up of small amounts.

Tallow dropped in value from $4,674,801 to $2,698,692, the former being the figures for 1900 and the latter for 1901. The quantities were 92,555,436 pounds and 51,846,765 pounds, respectively. The product is widely distributed geographically, and the decline seems to have been general, all the countries, with a few exceptions, being affected. The greatest gain is recorded by Mexico, although the trade with that country is not remarkably large. The amount sent there in 1900 was 448,539 pounds, valued at $25,771; last year it was 859,421 pounds, value, $44,661. Lesser gains were made by British North America, West Indies and Bermuda, Colombia, and Asia and Oceania.

Bacon shows a remarkable gain in value in 1901. The quantity exported in 1900, 469,924,828 pounds, was valued at $37,099,980, while last year the amount was 447,620,337 pounds and the value $39,402,500. Thus, although the quantity in 1901 was 22,304,491 pounds less, the value was greater by $2,302,520. This gain is most noticeable in the trade with Great Britain, where most of this product goes. The countries receiving more than $1,000,000 worth during the year were Great Britain, with $32,473,650; Germany, with $1,492,586, a slight decrease compared with the previous year; and other Europe, with $3,924,301, which is a small increase over 1900.

The trade in hams made very satisfactory progress in 1901. This product has, in fact, made steady and continuous gains for the past ten years, during which time the exports have more than trebled in value. The amount sent abroad last year was 230,456,004 pounds, valued at $24,739,003. This exceeds the business done in 1900 by $3,695,406, and, it may be remarked, is a considerably greater gain than the average for the ten years. As is the case with bacon, the greater part of the exports go to Great Britain, and the entire gain aforesaid is more than accounted for in the increased shipments to that country, the total value of which in 1901 amounted to $22,251,238. The commodity is widely distributed in smaller quantities.

Regarding our exports of pork, the major portion of which is of the salted or pickled variety, there was in 1901 an increase both in quantity and price. The exports of 1900 were 166,491,822 pounds, valued at $11,368,181. Last year they were 168,212,115 pounds, the value of which was $13,479,421. In the first case the price per pound works out to a trifle under 7 cents. In the latter to 8 cents. Thus we have in 1901 an enhancement in value of fully 1 cent per pound. The increase of $2,111,240, which the total of 1901 shows over the previous year, was participated in by all the importing countries except South America, and the decline there was by no means large, the totals being $295,038 for 1900, and $275,451 for 1901, showing a deficiency of less than $20,000.

Lard is the principal item in our exports of animal products. Some idea of the magnitude of the trade in this product may be given when it is stated that the value sent abroad in 1901 exceeded the value of corn exported in that year. In fact the only food products in the whole list of which a larger quantity was purchased by foreign countries were wheat and wheat flour. The quantity we exported in 1901 was 607,266,176 pounds, representing a value of $51,626,346. The amount for 1900 was 609,473,372 pounds, and the value $42,033,597. A comparison of these figures reveals an astonishing fact. It shows that we virtually received $10,000,000 more in 1901 for the same quantity of lard. Germany purchases lard from us in far greater quantity than any other animal product, the amount annually received almost equaling that sent to the United Kingdom. The latter country took 212,448,743 pounds, valued at $18,207,569, while 186,136,934 pounds, valued at $15,861,432 went to Germany. The trade with France has been declining for the past three years. The total for 1901 was 12,060,253 pounds, valued at $974,374, which was less than that of 1900 by 9,600,526 pounds in quantity and $487,113 in value. The greatest gains in 1901 were made in the case of the two large customers—Great Britain and Germany—each of which purchased about $4,000,000 worth more than in the preceding year. South America was enabled to hold its own, as compared with 1900, owing to increased shipments to Brazil, which country took 12,734,375 pounds for $1,162,557. But the other South American countries fell off somewhat. Cuba, also, did not show to as good advantage as in 1900, receiving 31,117,117 pounds for $2,435,689 as against 38,938,317 pounds, valued at $2,684,191, in the year named.

Oleo and oleomargarine was exported in 1901 to the amount of 168,923,216 pounds, valued at $13,451,234. Practically all of this product is oleo oil, oleomargarine or imitation butter only figuring to the extent of about 3 per cent of the total. The table shows that our shipments have steadily increased for the past five years. Our chief customer for this product is Netherlands, which buys about half of the entire output. The exports to that country in 1901 amounted to 87,190,024 pounds, valued at $6,763,659. Compared with the previous year this is a slight decrease in quantity but an increase in value. Germany comes next with 32,760,779 pounds, which were valued at $2,645,105. In this case the figures show a uniform advance both in quantity and value. However, the total for all countries in 1901 shows a distinct gain in value when compared with 1900. The average price per pound for the latter year was in the neighborhood of 7¼ cents. In 1901 it had risen to 8 cents.

The exports of poultry and game, sausage and sausage meats, and meat products not specified all show substantial advances in the past year. But such was not the case with sausage casings, which failed to keep up with the rapid gain made in 1900.

Dairy products do not show up in the aggregate quite so well as in 1900. This, however, does not apply to butter, a much larger quantity of which went abroad last year than in 1900. The figures were 24,249,565 pounds, valued at $4,184,966, while the amount exported in 1900 was only 13,283,557 pounds, of the value of $2,396,062. Milk also advanced from $1,288,127 to $1,646,579. But these gains were rather more than offset by the falling off in cheese. The amount of this article exported in 1901 was 31,396,115 pounds, the value being $3,006,344. This is 22,662,934 pounds less in quantity and $2,542,910 less in value than the previous year. Nearly all this deficit took place in the trade with Great Britain, an explanation of which is given in connection with the table showing the exports to that country.

The accompanying tables show, first, a comparative view of our exports of meat and dairy products for the past six years, and, second, a detailed statement of the exports of 1901, showing the quantity and value of each product, together with the country of destination:

Exports of meat and meat products and dairy products for the years 1896 to 1901.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article.	Quantity.	Value.	Article.	Quantity.	Value.
Beef, canned:	*Pounds.*	*Dollars.*	Bacon:	*Pounds.*	*Dollars.*
1896	61,168,927	5,335,283	1896	436,859,630	31,057,506
1897	42,804,831	3,728,607	1897	578,082,822	39,820,382
1898	37,866,632	3,448,240	1898	619,683,235	45,786,045
1899	49,393,218	4,529,550	1899	558,005,388	41,008,919
1900	51,915,745	5,150,013	1900	469,924,828	37,099,980
1901	53,239,582	5,233,782	1901	447,620,337	39,402,506
Beef, fresh:			Hams:		
1896	282,925,463	22,498,251	1896	156,912,852	15,224,842
1897	279,882,590	22,298,328	1897	171,956,663	16,581,659
1898	267,458,906	22,644,040	1898	220,011,750	20,384,650
1899	322,635,630	28,194,697	1899	216,646,559	21,015,536
1900	326,356,576	29,307,778	1900	198,328,048	21,043,567
1901	354,421,731	32,294,877	1901	230,456,004	24,739,003
Beef, other cured:			Pork, salted or pickled:		
1896	85,893,296	4,707,094	1896	63,544,168	3,204,988
1897	43,854,117	2,244,568	1897	68,764,530	3,563,945
1898	48,724,793	2,737,304	1898	116,865,578	6,804,048
1899	46,065,647	2,617,828	1899	137,573,905	7,996,794
1900	56,351,147	3,277,680	1900	140,915,057	9,380,613
1901	52,528,512	3,099,492	1901	127,863,335	10,254,696
Tallow:			Pork, fresh:		
1896	85,449,086	3,336,111	1896	315,345	18,161
1897	55,609,096	2,029,735	1897	4,185,059	289,227
1898	106,819,190	4,209,395	1898	30,464,516	2,027,365
1899	97,213,186	4,283,751	1899	34,041,243	2,334,826
1900	92,555,436	4,674,801	1900	25,576,765	1,987,568
1901	51,846,765	2,698,692	1901	40,348,780	3,224,726

Exports of meat and meat products and dairy products for the years 1896 to 1901—Cont'd.

Article.	Quantity.	Value.	Article.	Quantity.	Value.
Pork, canned:	*Pounds.*	*Dollars.*	Meat products not		
1899 [a]	3,570,524	270,577	specified—Cont'd.	*Pounds.*	*Dollars.*
1900	9,368,005	744,197	1898		5,190,547
1901	9,341,262	744,455	1899		5,810,965
Lard:			1900		5,015,000
1896	526,320,203	29,821,308	1901		5,672,446
1897	630,060,611	32,622,409	Poultry and game:		
1898	736,636,222	43,440,170	1896		51,981
1899	690,068,669	41,531,142	1897		66,316
1900	609,473,372	42,033,597	1898		91,819
1901	607,266,176	51,626,346	1899		236,322
Oleo oil and oleomar-			1900		679,440
garine:			1901		866,322
1896	120,686,267	8,255,849	Butter:		
1897	122,055,911	7,391,091	1896	27,220,213	3,909,900
1898	142,272,339	8,654,721	1897	30,914,783	4,497,878
1899	144,438,709	10,241,347	1898	15,034,189	2,428,143
1900	164,321,706	11,985,976	1899	27,309,869	4,502,744
1901	168,923,216	13,451,234	1900	13,283,557	2,396,062
Sausage and sausage			1901	24,219,565	4,184,966
meats:			Cheese:		
1900 [a]	5,867,982	543,804	1896	44,530,234	3,846,703
1901	7,140,383	699,841	1897	60,180,651	5,432,371
Sausage casings:			1898	40,523,994	3,376,818
1896		1,686,930	1899	34,686,833	3,376,108
1897		1,677,033	1900	54,059,049	5,549,254
1898		1,762,431	1901	31,396,115	3,006,344
1899		1,899,164	Milk:		
1900		2,931,603	1896		397,181
1901		2,022,496	1897		635,370
Meat products not			1898		692,925
specified:			1899		1,188,057
1896		2,413,281	1900		1,288,127
1897		3,243,188	1901		1,646,579

[a] Included in "All other meat products" previous to this date.

Quantity and value of exports of meat and meat products and dairy products for the calendar year 1901, by countries.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article and country to which exported.	Quantity.	Value.
Beef, canned:	*Pounds.*	*Dollars.*
United Kingdom	40,675,302	8,986,155
France	674,588	67,443
Germany	400,887	38,360
Other Europe	1,332,781	129,305
British North America	981,102	101,555
Central American States and British Honduras	254,034	25,957
Mexico	302,304	86,161
Santo Domingo	1,911	199
Cuba	103,011	10,058
Other West Indies and Bermuda	365,038	37,865

Quality and value of exports of meat and meat products and dairy products for the calendar year 1901, by countries—Continued.

Article and country to which exported.	Quantity.	Value.
Beef, canned—Continued.	*Pounds.*	*Dollars.*
Argentina	205	19
Brazil	106,493	10,698
Colombia	55,726	6,159
Other South America	203,661	21,585
China	108,686	15,383
British East Indies	67,837	7,891
Hongkong	137,412	19,570
Japan	127,437	18,012
British Australasia	208,497	19,285
Philippine Islands	74,740	10,539
Other Asia and Oceania	84,692	12,118
Africa	6,969,760	659,087
Other countries	3,528	430
Total	53,239,582	5,233,782
Beef, fresh:		
United Kingdom	350,624,203	31,899,293
British North America	123,194	15,748
West Indies and Bermuda	3,671,247	379,470
Other countries	3,087	366
Total	354,421,731	32,294,877
Beef, other:		
United Kingdom	18,112,375	1,110,603
France	148,890	7,697
Germany	7,642,475	470,553
Other Europe	7,897,767	442,825
British North America	5,997,571	321,063
Central American States and British Honduras	766,822	41,558
Mexico	13,823	1,407
Santo Domingo	57,300	3,425
Cuba	92,706	5,193
Other West Indies and Bermuda	5,723,553	322,574
Brazil	51,348	3,690
Colombia	239,895	13,772
Other South America	3,031,073	174,425
Asia and Oceania	1,495,948	113,843
Africa	1,208,116	64,028
Other countries	48,850	2,836
Total	52,528,512	3,099,492
Tallow:		
United Kingdom	20,234,636	1,015,143
France	5,560,246	290,459
Germany	6,292,070	337,088
Other Europe	13,823,089	732,492
British North America	78,406	3,561
Central American States and British Honduras	1,821,896	101,699
Mexico	859,421	44,663
Santo Domingo	240,873	12,651
Cuba	47,364	2,522
Other West Indies and Bermuda	1,043,806	58,691
Brazil	246,217	14,396
Colombia	82,339	5,565
Other South America	1,013,738	55,151

Quantity and value of exports of meat and meat products and dairy products for the calendar year 1901, by countries—Continued.

Article and country to which exported.	Quantity.	Value.
Tallow—Continued.	*Pounds.*	*Dollars.*
Asia and Oceania	109,957	6,205
Other countries	392,713	18,980
Total	51,846,765	2,698,692
Bacon:		
United Kingdom	363,736,542	32,473,650
France	1,960,196	155,969
Germany	19,031,622	1,492,586
Other Europe	46,956,069	3,768,332
British North America	6,874,954	719,069
Central American States and British Honduras	341,502	31,297
Mexico	306,164	34,564
Santo Domingo	14,270	1,299
Cuba	4,813,571	398,320
Other West Indies and Bermuda	397,437	41,940
Brazil	2,393,096	201,284
Colombia	24,600	2,159
Other South America	277,951	25,583
China	97,087	14,395
Philippine Islands	53,049	6,458
Other Asia and Oceania	114,667	15,959
Africa	227,560	19,636
Total	447,620,337	39,402,500
Hams:		
United Kingdom	206,318,614	22,251,238
France	320,856	31,454
Germany	2,409,370	254,646
Other Europe	8,307,999	830,628
British North America	2,865,346	309,229
Central American States and British Honduras	309,623	33,955
Mexico	452,647	54,719
Santo Domingo	95,192	12,696
Cuba	5,922,698	575,392
Other West Indies and Bermuda	1,898,555	193,770
Brazil	44,844	5,111
Colombia	161,226	16,796
Other South America	635,949	80,869
China	149,563	20,963
British Australasia	1,787	213
Philippine Islands	100,224	12,900
Other Asia and Oceania	233,178	30,623
Africa	206,225	21,353
Other countries	22,108	2,447
Total	230,456,004	24,739,003
Pork, canned	9,341,262	744,455
Pork, fresh and salted:		
United Kingdom	96,455,139	7,969,423
France	91,800	7,295
Germany	8,488,825	650,400
Other Europe	27,751,197	2,158,960
British North America	10,413,851	747,947
Central American States and British Honduras	1,334,557	102,401
Santo Domingo	109,300	8,811

Quantity and value of exports of meat and meat products and dairy products for the calendar year 1901, by countries—Continued.

Article and country to which exported.	Quantity.	Value.
Pork, fresh or salted—Continued.	*Pounds.*	*Dollars.*
Cuba	7,276,181	582,955
Other West Indies and Bermuda	12,461,784	949,053
Brazil	1,100	69
Colombia	187,269	15,021
Other South America	3,315,956	260,361
Asia and Oceania	66,620	5,476
Africa	121,100	8,942
Other countries	137,436	12,277
Total	168,212,115	13,479,421
Lard:		
United Kingdom	212,448,743	18,207,569
France	12,060,258	974,374
Germany	186,136,934	15,861,432
Other Europe	117,171,441	9,962,877
British North America	3,279,894	298,490
Central American States and British Honduras	2,012,493	178,233
Mexico	7,980,437	615,273
Santo Domingo	425,241	39,570
Cuba	31,117,117	2,435,689
Other West Indies and Bermuda	6,396,723	542,287
Argentina	108,588	10,181
Brazil	12,734,375	1,162,577
Colombia	1,201,698	98,568
Other South America	10,324,357	901,244
Philippine Islands	36,175	3,754
Other Asia and Oceania	1,314,258	101,207
Africa	2,472,394	229,784
Other countries	45,055	3,257
Total	607,266,176	51,626,346
Lard compounds, and substitutes for (cottolene, lardine, etc.)	30,513,728	2,029,698
Mutton	298,700	22,815
Oleo and oleomargarine:		
United Kingdom	8,535,927	739,313
Germany	32,760,779	2,645,105
Netherlands	87,190,024	6,763,659
Other Europe	35,059,842	2,777,278
British North America	1,768,053	152,858
Central American States and British Honduras	115,417	11,113
Mexico	40,005	3,733
West Indies and Bermuda	2,773,911	289,128
Colombia	78,155	6,999
Other South America	223,141	23,949
Philippine Islands	1,500	136
Other Asia and Oceania	87,992	8,336
Other countries	288,470	29,635
Total	168,923,216	13,451,234
Poultry and game		886,322
Sausage and sausage meats	7,140,383	699,841
Sausage casings		2,072,496
All other meat products.		
Canned		1,821,659
All other		3,850,858

Quantity and value of exports of meat and meat products and dairy products for the calendar year 1901, by countries—Continued.

Article and country to which exported.	Quantity.	Value.
Butter:	*Pounds.*	*Dollars.*
United Kingdom	17,146,965	3,046,395
Germany	552,714	86,462
Other Europe	622,526	87,626
British North America	905,475	178,345
Central American States and British Honduras	231,741	44,486
Mexico	378,351	71,942
Santo Domingo	106,729	16,115
Cuba	123,200	23,588
Other West Indies and Bermuda	1,620,130	271,707
Brazil	1,499,309	183,496
Colombia	71,187	14,138
Other South America	735,339	110,577
China	30,369	6,563
Japan	121,447	24,187
Philippine Islands	1,014	254
Other Asia and Oceania	68,056	12,789
Africa	10,076	2,336
Other countries	24,917	4,010
Total	24,249,565	4,184,966
Cheese:		
United Kingdom	29,179,866	2,740,947
Germany	5,295	540
British North America	359,996	35,019
Central American States and British Honduras	190,867	23,779
Mexico	302,228	35,714
Santo Domingo	46,186	5,755
Cuba	178,976	25,384
Other West Indies and Bermuda	617,504	76,509
Brazil	5,161	591
Colombia	66,392	8,298
Other South America	41,439	5,326
China	141,314	16,771
Japan	56,083	6,413
Philippine Islands	4,575	534
Other Asia and Oceania	185,217	22,972
Other countries	15,016	1,792
Total	31,396,115	3,006,344
Milk	....	1,646,579

WOOL AND WOOL MANUFACTURES.

We imported wool and manufactures of wool in 1901 to the value of $29,621,964. Of this total $15,604,532 was for manufactures and $14,017,432 for raw wool. The total is $5,394,210 less than the amount expended in 1900, the decrease, it may be remarked, being in the raw product, the manufactures remaining about the same.

A glance at the table below will show that the imports of clothing wool and combing wool have fluctuated considerably during the past four years, but our purchases of carpet wool have been more uniform

In 1900 we imported more clothing wool than carpet wool, but in 1901 the latter class, although not so large as it was the year before, nevertheless exceeded clothing and combing wool combined.

The falling off in our imports last year, mentioned above, took place more particularly in clothing and combing wool. The amount of the former imported in 1900 was valued at $8,498,228; last year it fell to $5,726,006. The decrease in combing wool was not so large actually, but was greater in proportion to the total, the amounts being $2,235,096 for 1900, and $981,294 for 1901.

Inasmuch as we are unable to supply the home demand for these products, it follows that our exports of the domestic article are not large, and it may be noticed that recently they have consisted almost entirely of manufactures. While the amount of home-grown wool exported in the past two years has been very small, attention may be called to the fact that quite a considerable quantity of foreign wool has been sent out of the country in recent years. The average annual value for the past three years amounted to over $1,000,000.

The accompanying tables show the value of the imports and exports for the past ten years, and those of 1901 by countries:

Value of imports of wool and wool manufactures for the years 1892 to 1901.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Calendar year.	Class 1 (clothing wool).	Class 2 (combing wool).	Class 3 (carpet wool).	Manufactures.	Total.
1892	$9,309,640	$1,375,651	$10,505,348	$37,515,445	$58,703,084
1893	5,373,238	895,266	7,485,045	30,238,506	44,182,055
1894	5,315,919	1,166,150	6,780,443	17,342,682	30,605,194
1895	19,657,912	4,092,656	10,019,591	60,319,331	94,089,490
1896	13,077,712	2,032,169	7,311,583	37,109,363	59,530,777
1897	33,953,828	6,946,102	12,532,300	29,330,284	82,762,214
1898	4,639,220	301,337	6,646,019	13,834,296	25,420,872
1899	2,803,680	1,499,276	7,356,688	14,596,847	26,256,491
1900	8,498,228	2,235,096	8,476,738	15,806,112	35,016,174
1901	5,726,006	981,294	7,310,132	15,604,532	29,621,964

Value of exports of wool and wool manufactures for the years 1892 to 1901.

Calendar year.	Raw wool.	Manufactures.	Total.
1892	$38,799	$273,835	$312,634
1893	36,139	559,379	595,518
1894	232,162	736,360	968,522
1895	689,874	782,855	1,472,729
1896	968,866	945,103	1,913,969
1897	144,608	1,058,956	1,203,564
1898	14,406	1,020,810	1,035,216
1899	566,295	1,229,539	1,795,834
1900	59,338	1,429,733	1,489,071
1901	15,039	1,531,972	1,547,011

Following is a table showing in detail the trade in wool and wool manufactures for the year 1901:

Quantity and value of imports and exports of wool and wool manufactures (including hair of goat, camel, etc.) for the calendar year 1901, by countries.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

IMPORTS.

Article and country from which imported.	Quantity.	Value.
CLASS 1.—*Clothing wool.*	*Pounds.*	*Dollars.*
United Kingdom	15,598,667	2,318,337
France	140,204	19,332
South America	16,224,142	1,511,540
Asia and Oceania	10,251,377	1,793,100
Other countries	662,793	83,697
Total	42,877,183	5,726,006
CLASS 2.—*Combing wool.*		
United Kingdom	3,032,722	582,775
Other Europe	216,920	70,386
British North America	1,629,311	270,466
South America	373,073	46,659
Asia and Oceania	26,158	11,004
Other countries	12	4
Total	5,278,196	981,294
CLASS 3.—*Carpet wool.*		
United Kingdom	27,152,355	2,795,924
France	2,304,056	247,725
Germany	2,688,562	297,256
Other Europe	15,720,908	1,748,780
British North America	5,324	567
South America	10,588,479	683,847
China	9,578,337	760,669
Other Asia and Oceania	6,677,397	671,448
Other countries	2,093,580	103,916
Total	76,808,998	7,310,132
Total unmanufactured	124,964,377	14,017,432
Carpets:	*Sq. yards.*	
United Kingdom	231,817	558,971
Other Europe	473,259	1,890,307
Japan	5,752	1,484
Other Asia and Oceania	172,018	517,247
Other countries	3,656	12,039
Total	886,502	2,980,018
Cloths:	*Pounds.*	
United Kingdom	2,772,309	2,858,398
Austria-Hungary	86,736	80,702
Belgium	15,331	14,463
France	200,092	230,035
Germany	1,011,978	971,875
Other Europe	3,523	3,517
Other countries	11,476	11,165
Total	4,101,445	4,170.155

Quantity and value of imports and exports of wool and wool manufactures (including hair of goat, camel, etc.) for the calendar year 1901, by countries—Continued.

IMPORTS—Continued.

Article and county from which imported.	Quantity.	Value.
CLASS 3.—*Carpet wool*—Continued.		
Dress goods:	*Square yards.*	*Dollars.*
United Kingdom	13,003,652	2,196,225
France	10,550,736	2,404,400
Germany	5,268,346	1,202,006
Other Europe	76,239	17,251
Other countries	11,257	2,334
Total	28,910,230	5,822,216
Total manufactured		15,604,532

EXPORTS.

	Pounds.	*Dollars.*
Raw wool	96,933	15,039
Manufactures:	*Square yards.*	
Carpets	119,514	96,481
Dress goods	13,444	6,900
Flannels and blankets		136,908
Wearing apparel		786,859
All other		504,824
Total		1,531,972

HIDES AND SKINS.

We purchase an enormous quantity of hides and skins (not including furs) annually in order to supply our wants. This quantity has been increasing rapidly in the past few years, the amount imported last year being more than double that of six years ago.

The imports of 1901 amounted to 310,539,594 pounds, valued at $55,565,388. This is an increase in value over the previous year of $3,977,395, and an increase in weight of 3,223,754 pounds, which proves that the price per pound was somewhat greater in 1901.

The Treasury reports subdivide hides and skins into three classes, namely, goatskins, which are admitted free of duty; hides of cattle, which are dutiable, and "All other," which are free of duty. The value of each class imported in 1901 was: Goatskins, $25,265,670; hides of cattle, $16,001,902; all other, $14,297,816. The values in 1900 were: Goatskins, $19,008,097; hides of cattle, $18,315,739; all other, $14,264,157.

It will be noticed that the last class remained stationary, while of the other two there is in one case an increase and in the other a decrease. The increase in the imports of goatskins was extremely large. We received 18,939,556 pounds more in quantity, and paid $6,257,573 in excess of the cost in 1900.

The value of the imports of hides of cattle decreased in 1901 to the extent of $2,313,837. The total quantity and value for the year named were 138,357,754 pounds and $16,001,902, respectively. A comparison of these figures with those of two years ago will show there has been an appreciable rise in value in the meantime. The total values for these years are practically the same, but fully 10,000,000 pounds more hides were obtained in 1899 for the money.

The table which follows shows the geographical distribution of the imports and exports for 1901:

Quantity and value of imports and exports of hides and skins (other than furs) for the calendar year 1901.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Country from which imported or to which exported.	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
United Kingdom	34,423,122	5,700,388	170,823	17,331
France	29,809,031	5,795,330	178,007	20,964
Germany	24,016,830	4,414,362	4,435,960	333,660
Other Europe	42,650,935	7,251,151	395,991	96,388
British North America	20,464,805	1,719,037	3,458,568	379,030
Central American States	3,075,666	484,505	....	....
Mexico	18,198,218	3,167,885	4,088	732
West Indies	1,934,181	377,507	17,793	4,679
South America	63,907,566	11,504,133	....	....
East Indies	49,894,847	10,105,730	....	....
Other Asia and Oceania	17,795,441	4,073,411	6,099	632
Africa	4,368,952	961,949	....	....
Japan	....	....	64,691	6,870
Other countries	....	....	4,475	675
Total	310,539,594	55,565,388	8,736,495	860,961

The tabular statement below shows the imports and exports for the six years 1896 to 1901, inclusive:

Imports and exports of hides and skins for the years 1896-1901.

Calendar year.	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
1896	146,159,006	20,713,528	42,009,166	3,481,364
1897	236,372,088	33,230,749	18,778,031	1,553,622
1898	256,188,970	39,906,373	11,397,129	1,018,433
1899	318,261,631	51,127,659	7,514,483	769,927
1900	307,315,840	51,587,993	10,635,394	1,051,435
1901	310,539,594	55,565,388	8,736,495	860,961

Quantity and value of imports of goatskins, morocco skins, and gloves for the years 1896 to 1901.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

	Goatskins.		Morocco leather.	Gloves.*
	Quantity.	Value.	Value.	Value.
	Pounds.	*Dollars.*	*Dollars.*	*Dollars.*
1896	38,882,234	8,803,609	2,808,322	5,618,311
1897	59,177,556	13,802,504	3,748,341	6,337,410
1898	65,546,570	16,854,430	2,452,655	5,686,464
1899	80,064,583	20,992,949	2,831,035	5,544,871
1900	69,104,372	19,008,097	2,940,949	6,433,941
1901	88,043,928	25,265,670	2,399,603	5,060,224

*Imported chiefly from Germany and France, and from other Europe in smaller quantities.

LEATHER AND LEATHER MANUFACTURES.

A perusal of the table below will demonstrate the fact that the balance of trade in these articles is largely in our favor. The imports of 1901 amounted altogether to $11,375,939, while the exports reached the total of $28,949,449.

The corresponding totals in 1900 were: Imports, $13,298,937; exports, $27,169,014. It is satisfactory to note, from a comparison of these figures, that the imports of last year show a decided decrease, while the exports on the other hand show an increase; that we, in other words, bought less and sold more.

It may be noted from the list of imports that the items we purchase are practically confined to three, namely, gloves, which is the chief article of import, skins for morocco, and dressed upper leather, etc.

Quantity and value of imports and exports of leather and leather manufactures for the calendar year 1901.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

IMPORTS.

Country from which imported or to which exported.	Quantity.	Value.
	Pounds.	*Dollars.*
Leather:		
Band or belting and sole leather		43,608
Calfskins, tanned, etc		183,259
Skins for morocco		2,399,603
Upper leather and skins, dressed, etc		2,931,516
Total		5,567,377
Leather manufactures:		
Gloves—		
Belgium		107,364
France		2,008,158
Germany		2,072,884

Quantity and value of imports and exports of leather and leather manufactures for the calendar year 1901—Continued.

IMPORTS—Continued.

Country from which imported or to which exported.	Quantity.	Value.
Leather manufactures—Continued.		
Gloves—Continued.	*Pounds.*	*Dollars.*
Other Europe		871,280
Other countries		540
All other		808,338
Total		5,868,562

EXPORTS.

Country from which imported or to which exported.	Quantity.	Value.
Sole leather:		
United Kingdom	31,528,017	5,545,181
Germany	38,865	7,307
Other Europe	3,454,214	699,953
British North America	656,194	130,528
West Indies and Bermuda	37,596	8,699
South America	29,498	8,177
Japan	900,423	230,411
British Australasia	280,869	76,150
Philippine Islands	22,935	6,477
Other Asia and Oceania	158,985	42,750
Africa	223,380	47,904
Other countries	114,601	30,805
Total	37,445,577	6,834,342
Other leather:		
United Kingdom		9,812,092
France		547,064
Germany		676,901
Other Europe		2,235,200
British North America		500,207
Central American States and British Honduras		25,058
Mexico		11,462
Santo Domingo		3,245
Cuba		77,657
Other West Indies and Bermuda		31,786
Argentina		71,121
Brazil		103,928
Colombia		6,261
Other South America		80,958
British Australasia		663,627
Philippine Islands		9,990
Other Asia and Oceania		34,021
Africa		51,228
Other countries		214
Total		14,942,020
Boots and shoes:		
United Kingdom		1,847,187
France		121,573
Germany		201,599
Other Europe		77,309
British North America		486,329
Central American States and British Honduras		158,876

Quantity and value of imports and exports of leather and leather manufactures for the calendar year 1901—Continued.

EXPORTS—Continued.

Country from which imported or to which exported.	Quantity.	Value.
Boots and shoes—Continued.	*Pounds.*	*Dollars.*
Mexico		567,559
West Indies and Bermuda		873,265
Colombia		42,971
Other South America		116,892
British Australasia		1,246,477
Philippine Islands		24,941
Other Asia and Oceania		47,321
Africa		181,722
Other countries		3,375
Total		5,997,463
Harness and saddles		346,143
All other manufactures		829,481

MISCELLANEOUS EXPORTS.

Below is a list of animal products exported in 1901 which have not been previously enumerated. The only item of considerable size is that of grease, grease scraps, etc., of which $3,030,889 worth was sent abroad.

Exports of miscellaneous articles for the calendar year 1901.

Bones, hoofs, horns, etc	$194,897
Candles	255,431
Feathers	324,135
Glue	268,705
Grease, grease scraps, etc	3,030,889
Hair and hair manufactures	603,689

COMMERCE WITH CUBA AND PORTO RICO.

Commerce of the United States, in animals and animal products, with Cuba and Porto Rico for the calendar year 1901.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article.	Cuba.				Porto Rico.			
	Imports.		Exports.		Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value
Animals:								
Cattle ....No.			68,730	$1,296,614				
Hogs ....No.			9,934	105,783				
Horses and mules, No			5,899	454,681	4	$375		
All other				93,620				
Bones, hoofs, horns, etc						1,816		
Grease, grease scraps, etc						282		
Hair and manufactures						35		

Commerce of the United States, in animals and animal products, with Cuba and Porto Rico for the calendar year 1901—Continued.

Article.	Cuba.				Porto Rico.			
	Imports.		Exports.		Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Hides and skins other than furs ....lbs..	....	....	....	....	562,440	$59,083	....	....
Provisions:								
Beef, fresh ......lbs..	....	....	2,881,000	$317,459	....	....	....	$1,118,676
All other beef products	....	....	....	17,801				
Lard ....lbs..	....	....	30,117,117	2,435,689				
All other hog products	....	....	....	1,574,841				
Lard compounds and substitutes....lbs..	....	....	7,688,468	527,573				
Dairy products	....	....	....	482,299				
All other provisions .	....	....	....	297,057				
Tallow ....lbs..	....	....	....	....	19,885	885	....	....
Leather:								
Boots and shoes . prs..	....	....	412,561	454,284	....	....	87,357	93,188
All other, and manufactures	....	....	....	161,788	....	....	....	43,239
Eggs ....doz..	....	....	2,387,267	417,164	....	....	....	....
Candles ....lbs..	....	....	....	....	....	....	543,202	45,267
Total values	....	....	....	8,636,653	....	62,476	....	1,300,370

COMMERCE WITH THE PHILIPPINE ISLANDS.

The only item of commerce in animals or animal products with the Philippine Islands for the calendar year 1901, enumerated by the Bureau of Statistics, Treasury Department, is an export of "Provisions, comprising meat and dairy products," to the value of $55,049. Nothing is enumerated among the imports.

NUMBERS AND VALUES OF FARM ANIMALS, 1900.

Number and value of domestic animals on farms and ranges June 1, 1900.

[From the census of 1900.]

State.	Neat cattle.		Milch cows.		Horses.		Mules.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Alabama	443,911	$3,283,505	355,823	$6,510,051	152,643	$7,906,121	192,070	$13,104,642
Alaska	5	500	13	810	5	465	....	....
Arizona	366,951	4,887,809	375,684	6,479,657	125,063	1,701,905	4,077	123,539
Arkansas	502,401	4,251,063	392,134	7,634,564	253,590	10,164,495	175,001	9,989,704
California	832,929	14,153,183	611,695	18,501,963	421,293	17,844,993	84,773	4,610,909
Colorado	850,163	17,926,998	583,155	17,605,740	236,546	7,308,726	6,784	325,547
Connecticut	82,630	1,471,817	134,428	4,472,448	52,576	3,813,632	278	22,735
Delaware	19,723	300,386	34,457	1,040,499	29,722	1,767,625	4,745	345,401
District of Columbia	173	3,122	1,289	51,349	854	57,362	81	6,050
Florida	386,719	2,610,578	364,542	3,733,771	42,811	2,290,139	13,664	1,074,972
Georgia	459,415	2,699,392	440,076	6,129,106	127,407	7,092,228	207,321	14,454,822
Hawaii	[a]65,932	708,179	36,976	585,587	12,982	441,661	6,506	590,507
Idaho	210,999	3,826,979	152,535	4,562,975	170,120	4,123,343	1,793	70,542
Illinois	1,867,415	40,653,304	1,236,595	41,517,603	1,350,219	69,698,100	124,644	7,420,511
Indiana	1,021,583	19,901,916	662,895	21,062,608	751,715	40,641,988	66,717	3,717,083
Indian Territory	1,052,236	19,982,337	447,128	9,656,334	217,699	6,223,718	56,858	2,878,825
Iowa	3,482,951	81,854,665	1,884,679	60,664,237	1,392,573	77,720,577	55,747	3,586,761
Kansas	2,954,697	70,583,651	1,536,381	47,057,150	979,695	43,758,334	118,704	6,507,916
Kentucky	667,478	13,110,286	415,770	11,877,455	451,697	24,548,542	190,665	11,105,553
Louisiana	360,711	3,045,439	309,584	5,535,557	194,372	6,624,617	143,970	10,636,982
Maine	152,772	2,253,480	186,075	5,332,065	106,299	7,058,989	353	19,530
Maryland	135,872	2,294,903	156,774	4,558,218	148,994	9,352,694	17,511	1,394,522
Massachusetts	91,436	1,321,873	194,508	6,809,044	75,034	5,826,457	298	20,685
Michigan	766,298	9,685,558	610,110	18,479,698	586,559	35,908,557	2,916	158,475
Minnesota	1,049,128	13,045,937	822,197	23,203,021	696,469	42,255,044	8,339	486,580
Mississippi	488,409	4,316,127	384,947	7,754,794	229,311	10,882,851	214,259	14,128,807

Missouri	1,889,005	42,889,896	1,089,584	32,766,911	967,037	42,094,814	283,519	15,482,282
Montana	611,838	14,204,459	356,549	11,157,557	329,972	7,788,672	2,729	102,741
Nebraska	1,989,674	44,724,658	1,186,569	37,744,840	795,318	36,663,359	55,124	3,171,460
Nevada	218,198	4,060,912	166,994	4,212,348	80,295	1,272,336	2,792	85,601
New Hampshire	98,654	1,612,190	128,138	3,934,440	54,866	3,840,670	97	6,072
New Jersey	74,600	1,119,696	165,384	6,075,421	94,024	7,582,274	4,888	354,037
New Mexico	472,219	7,613,859	519,640	10,364,072	131,153	2,220,469	5,311	183,132
New York	996,315	11,647,414	1,600,074	51,087,760	628,438	47,977,931	3,313	229,172
North Carolina	330,258	2,565,512	294,260	5,102,438	159,153	8,795,611	135,610	8,677,298
North Dakota	423,785	8,306,988	233,649	7,503,649	359,948	22,728,511	6,880	476,366
Ohio	1,148,034	19,487,792	905,279	27,072,454	878,205	50,159,245	16,771	941,211
Oklahoma	1,105,643	22,793,605	604,109	14,989,510	303,631	10,615,294	55,677	2,828,630
Oregon	394,756	6,512,457	305,547	8,652,440	287,932	8,651,060	7,446	318,249
Pennsylvania	904,267	12,700,369	992,580	30,362,822	590,981	40,948,827	38,059	2,907,690
Rhode Island	10,995	190,657	25,039	975,140	11,390	980,948	38	2,835
South Carolina	173,979	1,264,858	168,919	3,069,856	78,419	4,846,903	117,369	8,415,523
South Dakota	996,456	21,243,731	532,030	16,169,622	466,901	19,851,437	6,804	345,609
Tennessee	540,947	6,302,050	371,236	9,099,001	352,388	19,681,517	253,657	16,200,550
Texas	5,197,293	76,571,951	4,230.903	86,656,953	1,269,432	34,497,083	507,281	25,121,619
Utah	180,936	2,762,624	162,754	4,390,220	115,884	3,396,313	2,116	58,850
Vermont	210,031	2,315,013	291,909	8,213,782	85,531	5,319,597	331	21,847
Virginia	502,901	9,388,425	322,611	7,450,422	298,522	15,326,404	47,474	2,941,765
Washington	229,296	3,641,346	165,627	5,798,692	243,985	8,550,434	2,690	138,185
West Virginia	397,311	7,467,846	242,471	6,590,581	185,188	10,376,550	11,354	725,134
Wisconsin	1,246,614	15,476,123	1,067,491	31,373,295	555,756	34,316,475	4,490	243,493
Wyoming	424,153	10,741,201	263,131	8,651,990	135,543	3,225,196	1,227	51,609
Total	39,081,095	695,782,624	28,722,927	780,282,510	18,266,140	896,721,093	3,271,121	196,812,560

[a] Includes 80 Chinese buffaloes and 47 working bullocks.

Number and value of domestic animals on farms and ranches June 1, 1900—Continued.

State.	Asses and burros.		Sheep.		Swine.		Goats.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Alabama	1,819	$134,826	317,053	$488,299	1,423,329	$2,887,230	117,413	$94,258
Alaska	....	....	....	....	10	100	....	....
Arizona	4,625	32,162	924,761	1,901,764	18,103	80,587	98,403	167,863
Arkansas	2,479	222,185	256,929	437,317	1,713,307	2,981,309	51,839	58,788
California	2,227	146,697	2,563,353	7,003,231	598,336	2,476,781	109,021	262,981
Colorado	5,513	52,010	2,044,814	5,584,897	101,198	482,722	37,433	73,141
Connecticut	24	780	36,987	137,420	46,447	326,857	318	1,945
Delaware	15	845	11,765	43,588	46,732	234,472	143	519
District of Columbia	....	....	....	....	802	4,097	9	39
Florida	98	3,445	124,520	239,261	464,277	702,827	43,705	32,639
Georgia	519	45,850	336,278	438,363	1,424,298	2,577,950	84,624	61,972
Hawaii	1,438	13,355	102,098	183,883	8,057	49,576	653	731
Idaho	362	10,733	3,121,532	8,294,776	114,080	480,338	4,481	20,167
Illinois	2,529	223,147	1,030,581	3,706,642	5,915,468	23,616,781	8,877	19,932
Indiana	1,008	116,144	1,742,002	5,794,976	3,763,389	13,804,893	4,484	8,920
Indian Territory	1,262	117,940	17,005	37,994	630,256	1,906,200	10,529	21,538
Iowa	1,832	150,708	1,056,718	3,956,142	9,723,791	43,764,176	41,468	146,708
Kansas	3,787	428,176	262,013	833,827	3,594,859	17,076,904	18,288	71,290
Kentucky	5,259	459,210	1,297,343	4,191,205	1,954,587	5,176,183	11,967	19,753
Louisiana	683	51,685	219,844	333,040	788,425	1,494,284	38,308	35,697
Maine	48	769	420,116	1,116,483	79,018	516,015	279	1,091
Maryland	69	6,810	191,101	696,581	317,902	1,329,143	1,179	4,023
Massachusetts	51	1,709	52,559	198,596	78,925	549,617	1,254	7,188
Michigan	95	3,193	2,747,009	7,162,664	1,165,200	4,588,898	2,861	10,008
Minnesota	161	11,475	589,878	1,740,088	1,440,806	5,865,590	3,821	12,908
Mississippi	1,773	216,609	312,632	584,945	1,290,498	2,963,573	55,388	45,594
Missouri	8,777	1,111,893	1,087,213	3,350,846	4,524,664	16,533,935	24,487	64,786
Montana	128	16,008	6,170,483	15,165,404	49,496	281,402	1,713	7,870
Nebraska	782	116,756	511,273	1,678,498	4,128,000	18,060,932	2,399	9,126
Nevada	296	28,880	867,039	2,344,803	15,174	75,712	4,633	12,948

New Hampshire	27	1,565	105,113	309,451	51,211	357,573	208	916
New Jersey	43	2,455	47,730	202,490	175,387	926,179	699	3,006
New Mexico	15,902	64,528	4,899,487	10,643,514	20,426	81,644	224,136	472,961
New York	338	8,109	1,745,746	5,921,941	676,639	3,794,332	1,316	6,442
North Carolina	825	69,460	301,941	477,421	1,300,469	2,516,410	42,901	37,997
North Dakota	96	13,231	681,952	1,987,136	191,798	930,470	1,122	5,308
Ohio	250	18,981	4,020,028	10,956,308	3,188,563	11,813,168	5,432	16,975
Oklahoma	1,521	124,171	71,358	179,738	584,878	2,380,025	3,772	10,854
Oregon	305	42,423	3,040,291	7,563,447	281,406	1,057,037	109,661	375,229
Pennsylvania	576	22,559	1,531,066	4,642,606	1,107,981	5,830,295	2,197	8,951
Rhode Island	5	210	11,207	41,282	11,508	90,614	23	131
South Carolina	247	22,353	71,538	111,770	618,995	1,411,516	26,576	24,450
South Dakota	195	19,021	775,236	2,434,206	823,120	3,540,072	2,915	15,050
Tennessee	8,852	708,702	496,011	1,179,424	1,976,984	4,838,718	25,884	38,988
Texas	16,409	808,747	1,889,298	3,982,117	2,665,614	7,605,687	627,338	923,777
Utah	888	15,555	3,818,423	10,256,488	65,782	293,115	1,427	2,702
Vermont	25	915	296,576	881,402	95,090	620,169	102	444
Virginia	412	52,231	692,929	2,089,779	946,443	2,572,524	5,305	10,002
Washington	100	16,481	929,873	2,450,929	181,535	830,704	2,876	10,757
West Virginia	116	15,234	968,843	2.664,556	442,844	1,389,808	847	2,123
Wisconsin	428	8,505	1,675,458	4,510,356	2,014,631	7,580,423	3,882	12,760
Wyoming	414	10,087	5,099,618	16,310,096	15,471	78,145	2,666	11,884
Total	95,603	5,824,539	61,605,811	170,337,002	62,876,108	232,027,707	1,871,252	3,266,080

Domestic animals in barns and inclosures, not on farms and ranges, June 1, 1900.

[From the census of 1900.]

State.	Neat cattle.	Milch cows.	Horses.	Mules.	Asses.	Sheep.	Swine.	Goats.
Alabama	25,022	24,165	18,558	7,301	200	6,382	50,132	4,749
Arizona	359	664	4,791	378	856	119	315	32
Arkansas	22,859	22,203	25,223	7,160	247	2,651	51,961	1,754
California	7,620	19,349	83,834	2,232	443	5,326	7,754	1,840
Colorado	7,812	10,527	32,949	1,773	1,043	234	2,374	356
Connecticut	1,516	6,326	40,588	47	18	146	4,871	234
Delaware	178	1,060	6,689	297	4	11	4,115	61
District of Columbia	47	484	11,578	276	1	30	332	64
Florida	6,180	6,809	7,531	3,254	59	854	15,114	1,341
Georgia	14,921	22,699	21,016	7,540	126	5,745	39,538	2,045
Idaho	1,536	2,589	9,232	373	129	226	1,840	1
Illinois	52,332	58,308	238,650	6,271	424	52,702	155,050	2,952
Indiana	13,859	38,015	127,257	4,359	224	6,125	76,287	796
Indian Territory	7,453	8,285	16,668	2,475	135	49	15,280	276
Iowa	18,685	57,642	153,304	5,203	503	2,291	122,788	783
Kansas	14,836	37,145	84,647	3,197	535	640	52,134	356
Kentucky	12,211	23,193	44,892	7,287	377	3,434	52,992	627
Louisiana	15,099	13,768	26,082	6,802	269	2,094	23,787	2,078
Maine	3,512	12,083	33,745	50	18	6,634	9,459	36
Maryland	2,548	10,402	38,525	2,216	71	1,193	36,616	375
Massachusetts	3,043	15,335	132,359	488	55	2,180	16,897	493
Michigan	10,706	38,051	102,105	378	89	4,461	22,592	599
Minnesota	10,456	36,098	85,063	780	55	3,207	17,487	288
Mississippi	19,592	18,059	15,552	4,299	243	3,109	22,577	1,839
Missouri	21,784	50,081	127,290	12,560	652	2,071	81,789	988
Montana	1,597	3,384	12,323	235	16	38	327	10
Nebraska	6,590	24,835	60,201	1,987	199	157	43,965	308
Nevada	214	570	2,582	283	16	49	257	19
New Hampshire	954	4,117	22,323	30	11	589	5,745	46

New Jersey	1,701	10,715	81,790	1,116	78	209	15,448	1,743
New Mexico	1,068	1,419	7,216	496	1,184	70	1,005	1,223
New York	13,599	36,619	304,264	1,859	420	9,654	41,969	3,041
North Carolina	6,258	14,242	15,690	3,110	88	1,087	39,144	1,087
North Dakota	2,129	5,511	12,946	191	16	139	2,217	34
Ohio	12,160	51,260	188,996	4,732	212	9,047	95,804	1,148
Oklahoma	1,223	3,630	12,909	1,314	104	11	4,245	60
Oregon	4,324	10,073	17,348	300	43	734	3,553	57
Pennsylvania	19,195	79,320	218,194	22,167	601	6,060	150,329	6,547
Rhode Island	255	1,380	19,401	9	1	18	1,345	73
South Carolina	4,892	9,935	9,798	2,801	54	422	11,527	671
South Dakota	3,284	9,052	21,605	394	37	535	5,374	50
Tennessee	18,691	31,099	38,939	10,504	538	3,173	81,749	1,419
Texas	49,953	66,154	110,024	15,590	1,992	357	89,013	1,769
Utah	3,439	8,742	12,146	122	39	2,920	5,680	36
Vermont	1,851	6,462	20,344	31	5	942	5,359	49
Virginia	7,670	20,309	27,741	3,072	209	2,662	51,455	1,005
Washington	6,218	11,689	19,371	376	22	436	4,135	103
West Virginia	3,653	11,790	17,917	3,488	58	1,817	21,914	667
Wisconsin	9,447	34,252	85,199	452	101	3,547	27,101	1,517
Wyoming	598	1,642	6,482	460	50	82	120	3
Total	475,429	991,541	2,833,877	162,115	12,870	156,470	1,592,861	47,652

WOOL PRODUCT OF THE UNITED STATES, 1901.

The following table, in most of its features, is taken from the Bulletin of the National Association of Wool Manufacturers for December, 1901. The numbers of sheep in the bulletin were preliminary estimates of the census; in this table the corrected returns of the census for 1900 are substituted, and other figures are changed accordingly. The other figures are for the year 1901. One of the valuable features of this table is that it shows the character of wool produced in the several States and Territories. It also shows the percentage of shrinkage upon scouring, as well as the value per pound of the scoured wool:

State or Territory.	Quality.	Number of sheep.*	Average weight of fleece, 1901.	Per cent of shrinkage, 1901.	Wool, washed and unwashed.	Wool, scoured.	Average value per scoured pound, Oct. 1.		Total value, 1901.
							1900.	1901.	
			Pounds.		*Pounds.*	*Pounds.*	*Cents.*	*Cents.*	
Maine	Medium	426,750	6	40	2,560,500	1,536,300	46⅔	35	$537,705
New Hampshire	½ fine, ½ medium	105,702	6½	55	687,063	309,178	53⅓	42½	131,401
Vermont	....do	297,518	6¾	56	2,008,246	883,628	53⅓	42½	375,542
Massachusetts	¼ fine, ¾ medium	54,789	6	48	328,434	170,786	50	38¾	66,180
Rhode Island	Medium	11,225	5½	42	61,737	35,807	46⅔	35	12,532
Connecticut	....do	37,183	5½	41	204,231	120,496	46⅔	35	42,174
New York	¼ fine, ¾ medium	1,755,400	6	50	10,532,400	5,266,200	51	40	2,106,480
New Jersey	Medium	47,939	5	47	239,695	127,038	46⅔	35	44,463
Pennsylvania	¼ fine, ¾ medium	1,537,126	6	50	9,222,756	4,611,378	52⅔	41⅔	1,921,407
Delaware	Medium	11,776	5	46	58,880	31,795	46⅔	35	11,128
Maryland	....do	192,294	5	47	961,470	509,579	46⅔	35	178,353
West Virginia	¾ fine, ¼ medium	970,660	5½	47	5,338,630	2,829,474	60⅔	50	1,414,737
Kentucky	Medium	1,300,777	5	38	6,503,885	4,032,409	46⅔	35	1,411,343
Ohio	¾ fine, ¼ medium	4,029,675	5¼	51	21,155,794	10,366,339	59½	48⅓	5,010,397
Michigan	....do	2,752,070	6½	52	17,888,455	8,586,458	55	45	3,863,906
Indiana	¼ fine, ¾ medium	1,748,127	6½	52	11,362,825	5,454,156	51	40	2,181,662
Illinois	½ fine, ½ medium	1,083,284	6½	50	7,041,846	3,520,678	50	40	1,408,269
Wisconsin	¼ fine, ¾ medium	1,679,000	6½	51	10,913,500	5,347,615	50	40	2,139,046
Minnesota	½ fine, ½ medium	593,085	6½	53	3,855,052	1,811,874	50	40	724,750
Iowa	....do	1,059,000	6½	55	6,883,558	3,097,601	50	40	1,239,040
Missouri	¼ fine, ¾ medium	1,089,284	6	50	6,535,704	3,267,852	48⅔	38¾	1,266,298

Virginia	Medium	695,591	5	42	3,477,955	2,017,214	46½	35	706,025
North Carolina	....do	303,028	4¼	42	1,287,869	746,964	43	32	239,028
South Carolina	....do	71,960	4¼	42	305,830	177,381	43	32	56,762
Georgia	....do	342,023	4	40	1,368,092	820,855	43	32	262,674
Florida	....do	125,874	4	42	501,496	290,868	43	32	93,078
Alabama	....do	323,435	4	40	1,293,740	776,244	43	32	248,398
Mississippi	....do	315,741	4½	42	1,420,834	824,084	43	32	263,707
Louisiana	....do	221,938	4	45	887,752	488,264	43	32	156,244
Arkansas	....do	259,580	4¼	40	1,103,215	661,929	43	32	211,817
Tennessee	....do	499,184	4¼	40	2,121,582	1,272,919	43	32	407,334
Kansas	Fine, fine medium, and medium	262,653	8	67	2,101,224	693,404	52½	40	277,362
Nebraska	....do	511,430	7½	63	3,835,725	1,419,218	52½	40	567,687
South Dakota	....do	775,571	6½	60	5,041,211	2,016,484	52½	38	766,264
North Dakota	....do	682,091	6½	60	4,433,591	1,773,436	52½	38	673,906
Montana	....do	6,170,521	6¾	63	41,651,016	15,410,876	52½	43	6,626,677
Wyoming	....do	5,099,695	7½	67	38,247,712	12,621,745	52½	43	5,427,350
Idaho	....do	3,121,758	7¼	67	22,632,746	7,468,806	52½	40	2,987,522
Washington	....do	930,309	8	73	7,442,472	2,009,467	52½	40	803,787
Oregon	....do	3,041,025	8	70	24,328,200	7,298,460	52½	42	3,065,353
California	½ fall, ½ spring	2,568,679	7	66	17,980,753	6,113,456	48½	40	2,445,382
Nevada	Fine, fine medium, and medium	887,068	7¼	68	6,431,388	2,058,044	52½	43	884,959
Utah	....do	3,821,343	6	64	22,928,058	8,254,101	52½	40	3,301,640
Colorado	....do	2,045,048	6¼	67	12,781,550	4,217,912	52½	38	1,602,807
Arizona	....do	924,880	7½	72	6,936,600	1,942,248	52½	40	776,899
New Mexico	....do	4,899,557	4¼	52	20,823,117	9,995,096	52½	38	3,798,136
Texas	½ fall, ½ spring	1,889,655	6½	70	12,282,757	3,684,827	51½	43⅔	1,609,041
Oklahoma	Fine, and fine medium	71,369	6½	63	463,898	171,642	51	40	68,657
Total		ᵇ61,643,099	6½	60	388,454,494	157,142,580	....	41	64,415,304
Pulled wool					37,000,000	22,200,000	....	36.7	8,155,000
Total product					425,454,494	179,342,580	....	40½	72,570,304

ᵃTaken from the census returns of 1900.

ᵇIn addition to this total the census returns give 17,054 sheep in Indian Territory, 102,098 in Hawaii, and 30 in the District of Columbia. These are not included in the table because the particulars concerning the wool, etc., are not available.

ᶜBasis value fine Ohio, West Virginia, and Pennsylvania, scoured, 55 c.; Michigan, New York, and similar, scoured, 50 c.; Texas, 12 mos. and 8 mos., 46½ c.; fall Texas, 38 c. Basis value California, 12 mos. and 8 mos., scoured, 42 c.; fall California, scoured, 36 c.; Kansas, Indiana, Missouri, and similar, scoured, 35 c.; Georgia, and similar Southern, scoured, 32 c.

PORK PACKING IN THE UNITED STATES.

PORK PACKING IN THE WEST.

The following statistics of pork packing, copied from the Cincinnati Price Current, are of great importance as illustrating the volume and growth of the pork-packing industry:

WINTER PACKING IN THE WEST.

Number of hogs packed in the West during the winter season, November 1 to March 1, according to returns received by the Cincinnati Price Current.

City.	1901-02.	1900-01.	City.	1901-02.	1900-01.
Chicago, Ill	3,433,905	2,970,095	Peoria, Ill	8,641	9,643
Kanssas City, Mo	1,271,686	1,178,320	Quincy, Ill	35,000	37,629
South Omaha, Nebr	938,787	786,156	Burlington, Iowa	3,100	3,300
St. Louis, Mo	642,030	667,000	Davenport, Iowa	19,000	17,400
St. Joseph, Mo	806,813	604,647	Des Moines, Iowa	30,000	....
Indianapolis, Ind	476,568	434,250	Marshalltown, Iowa	43,886	58,301
Milwaukee, Wis	87,949	141,208	Cape Girardeau, Mo	1,500	1,600
Cudahy, Wis	234,220	255,090	Jackson, Mo	1,194	1,328
Cincinnati, Ohio	232,882	244,932	Leavenworth, Kans	....	8,000
Sioux City, Iowa	372,703	261,835	Topeka, Kans	42,859	39,929
St. Paul, Minn	320,393	242,626	Austin, Minn	19,172	13,751
Ottumwa, Iowa	249,530	254,623	Eau Claire, Wis	17,989	16,297
Cedar Rapids, Iowa	200,455	193,598	Jefferson, Wis	10,000	8,000
Cleveland, Ohio	168,733	163,600	La Crosse, Wis	4,300	5,000
Louisville, Ky	150,000	143,982	Chattanooga, Tenn	....	5,000
Detroit, Mich	96,069	83,235	Knoxville, Tenn	6,000	4,740
Nebraska City, Nebr	51,741	....	Morristown, Tenn	3,000	2,000
Wichita, Kans	46,507	55,044	Nashville, Tenn	....	16,500
Dayton, Ohio	30,000	35,000	Pittsburg and Allegheny, Pa	75,000	82,000
Hamilton, Ohio	5,000	5,000	Dallas, Tex	13,971	19,758
Lancaster, Ohio	2,000	1,000	Fort Worth, Tex	32,881	55,000
Toledo, Ohio	2,775	3,200	Sherman, Tex	9,558	30,000
Evansville, Ind	9,000	3,200	Wheeling, W. Va	25,000	....
Fort Wayne, Ind	12,000	7,000	Denver	35,000	42,000
Logansport, Ind	6,000	10,564	Total all places	10,340,196	9,277,750
Alton, Ill	11,500	9,780			
Bloomington, Ill	43,899	45,579			

SUMMER PACKING IN THE WEST.

Number of hogs packed in the West during the summer season, March 1 to November 1, according to returns received by the Cincinnati Price Current.

City.	1901.	1900.	City.	1901.	1900.
Chicago, Ill	4,202,095	4,298,420	Indianapolis, Ind	748,742	751,300
Kansas City, Mo	2,156,116	1,802,968	Milwaukee, Wis	201,446	192,332
South Omaha, Nebr	1,451,629	1,455,443	Cudahy, Wis	266,448	322,538
St. Joseph, Mo	1,298,480	1,118,730	Cincinnati, Ohio	336,900	372,100
St. Louis, Mo	1,083,377	939,550	Sioux City, Iowa	507,060	471,919

Number of hogs packed in the West during the summer season, March 1 to November 1, according to returns received by the Cincinnati Price Current—Continued.

City.	1901.	1900.	City.	1901.	1900.
St. Paul, Minn	338,198	271,759	Logansport, Ind.	7,830	6,500
Ottumwa, Iowa	360,472	399,162	Fort Wayne, Ind	6,000	5,000
Cedar Rapids, Iowa	296,335	302,710	Evansville, Ind	....	3,500
Cleveland, Ohio	327,498	337,185	Dayton, Ohio	55,000	65,000
Louisville, Ky	225,000	216,443	Toledo, Ohio	6,560	6,000
Detroit, Mich	176,495	162,761	Hamilton, Ohio	5,000	5,000
Nebraska City, Nebr	129,005	114,962	Austin, Minn	19,238	....
Wichita, Kans	165,600	101,634	Eau Claire, Wis	13,736	15,272
Topeka, Kans	83,847	48,922	Nashville, Tenn	....	39,300
Leavenworth, Kans	10,400	8,000	Knoxville, Tenn	960	1,700
Marshalltown, Iowa	60,578	62,300	Fort Worth, Tex	86,500	60,035
Des Moines, Iowa	42,102	....	Dallas, Tex	37,324	35,562
Davenport, Iowa	18,850	21,700	Sherman, Tex	33,486	....
Burlington, Iowa	4,600	4,815	Pittsburg and Allegheny,		
Clinton, Iowa	....	29,600	Pa	77,000	87,000
Bloomington, Ill	61,600	59,598	Wheeling, W. Va	50,000	....
Quincy, Ill	25,546	22,192	Denver, Colo	65,000	70,000
Alton, Ill	18,000	20,518	Total all places	15,071,480	14,322,924
Peoria, Ill	11,437	13,356			

YEARLY PACKING COMPARISONS.

Total number of hogs packed in the West for twelve months ended March 1, at prominent places mentioned, for two years, and for all other places.

City.	1901-02.	1900-01.	City.	1901-02.	1900-01.
Chicago, Ill	7,636,000	7,268,515	Louisville, Ky	375,000	360,425
Kansas City, Mo	3,427,802	2,981,288	Detroit, Mich	272,564	245,996
South Omaha, Nebr	2,390,416	2,241,599	Nebraska City, Nebr	180,746	114,962
St. Louis, Mo	1,725,407	1,566,550	Wichita, Kans	212,107	156,678
St. Joseph, Mo	2,105,293	1,723,377	Topeka, Kans	126,706	88,851
Indianapolis, Ind	1,225,310	1,185,600	Marshalltown, Iowa	104,464	120,601
Milwaukee, Wis	289,395	333,540	Bloomington, Ill	105,499	105,177
Cudahy, Wis	500,668	577,716	Pittsburg, Pa	152,000	176,000
Cincinnati, Ohio	569,782	617,032	Fort Worth, Tex	119,381	115,035
Sioux City, Iowa	879,763	733,754	Dallas, Tex	51,295	55,320
St. Paul, Minn	658,591	514,385	Denver, Colo	100,000	112,000
Ottumwa, Iowa	610,002	653,785	All other	600,464	555,395
Cedar Rapids, Iowa	496,790	496,308	Total, 12 months	25,411,676	23,600,674
Cleveland, Ohio	496,231	500,785			

WINTER PACKING IN THE WEST, 1842–43 TO 1901–02.

Total number of hogs packed in the West during winter seasons, and cost of hogs per 100 pounds, live weight, according to the Cincinnati Price Current special reports since 1849, and estimates previously from best available data.

Season.	Number.	Cost.	Season.	Number.	Cost.
1901–02	10,340,196	$5.97	1871–72	4,831,558	$4.12
1900–01	9,277,750	5.02	1870–71	3,695,251	5.26
1899–00	8,675,898	4.29	1869–70	2,635,312	9.22
1898–99	9,720,145	3.52	1868–69	2,499,873	8.18
1897–98	8,440,785	3.53	1867–68	2,781,084	6.36
1896–97	6,949,090	3.30	1866–67	2,490,791	5.78
1895–96	6,815,800	3.68	1865–66	1,785,955	9.34
1894–95	7,191,520	4.28	1864–65	2,422,779	11.46
1893–94	4,884,082	5.26	1863–64	3,261,105	5.26
1892–93	4,633,520	6.54	1862–63	4,069,520	3.39
1891–92	7,761,216	3.91	1861–62	2,893,666	2.42
1890–91	8,173,126	3.54	1860–61	2,155,702	4.57
1889–90	6,663,802	3.66	1859–60	2,350,822	4.73
1888–89	5,483,852	4.99	1858–59	2,465,552	5.02
1887–88	5,921,181	5.04	1857–58	2,210,778	3.89
1886–87	6,439,009	4.19	1856–57	1,818,468	4.75
1885–86	6,298,995	3.66	1855–56	2,489,502	4.60
1884–85	6,460,240	4.29	1854–55	2,124,404	3.37
1883–84	5,402,064	5.18	1853–54	2,534,770	3.35
1882–83	6,132,212	6.28	1852–53	2,201,110	4.81
1881–82	5,747,760	6.06	1851–52	1,182,846	3.56
1880–81	6,919,456	4.64	1850–51	1,332,867	3.00
1879–80	6,950,451	4.18	1849–50	1,652,220	2.15
1878–79	7,480,648	2.85	1848–49	1,560,000	2.75
1877–78	6,505,446	3.99	1847–48	1,710,000	2.60
1876–77	5,101,308	5.74	1846–47	825,000	2.85
1875–76	4,880,135	7.05	1845–46	940,000	3.90
1874–75	5,566,226	6.66	1844–45	790,000	2.65
1873–74	5,466,200	4.34	1843–44	1,245,000	....
1872–73	5,410,314	3.73	1842–43	675,000	....

WEIGHT AVERAGES OF HOGS IN THE WEST, 1873 TO 1902.

Average weight of hogs, in pounds, in the West, for the winter seasons ended March 1.

Year.	Weight.	Year.	Weight.	Year.	Weight.
1873	290.53	1883	267.02	1893	227.79
1874	268.71	1884	251.44	1894	248.20
1875	262.21	1885	266.51	1895	232.73
1876	272.13	1886	258.98	1896	240.71
1877	269.90	1887	251.31	1897	244.80
1878	282.55	1888	242.30	1898	235.35
1879	271.42	1889	263.46	1899	232.65
1880	266.17	1890	250.92	1900	235.67
1881	259.63	1891	239.75	1901	230.32
1882	262.70	1892	247.64	1902	206.38

PORK PACKING IN THE EAST.

The aggregate number of hogs packed during the year ended March 1 at Eastern points, from which returns and estimates have been obtained by the Cincinnati Price Current, embracing Boston, New Haven, Providence, Worcester, Brightwood, Fall River, Bridgeport, etc., in New England States; Buffalo, Albany, Troy, Hudson, etc., in New York State; and Pottsville, Harrisburg, Mount Carmel, Allentown, Chester, Coatesville, etc., in Pennsylvania, is shown in the following, for summer and winter seasons and for the year:

Pork packing in the East, 1882-83 to 1901-02.

Year.	Summer.	Winter.	Twelve months.
1882-83	824,031	509,071	1,333,102
1883-84	848,153	628,294	1,476,447
1884-85	935,238	614,516	1,549,754
1885-86	991,448	687,810	1,679,258
1886-87	1,113,410	807,115	1,920,525
1887-88	1,306,849	951,708	2,258,557
1888-89	1,231,069	859,494	2,090,563
1889-90	1,378,520	959,813	2,338,333
1890-91	1,473,961	1,066,200	2,540,161
1891-92	1,658,409	1,113,754	2,772,163
1892-93	1,989,720	1,026,310	3,016,030
1893-94	1,638,205	1,063,029	2,701,234
1894-95	1,863,000	1,235,500	3,098,500
1895-96	1,546,500	1,056,000	2,602,500
1896-97	1,659,800	1,131,100	2,790,900
1897-98	1,883,600	1,188,500	3,072,100
1898-99	1,895,000	1,269,000	3,164,000
1899-00	1,996,000	1,096,000	3,092,000
1900-01	1,683,000	1,077,000	2,760,000
1901-02	1,728,000	1,021,000	2,749,000

Summary of receipts and shipments of live stock at leading cities in 1901.

Stock center.	Cattle.		Calves.		Hogs.		Sheep.		Horses.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
	Number.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
Chicago	3,031,396	1,031,576	181,824	19,387	8,290,494	1,300,962	4,044,095	763,292	109,353	102,738
Kansas City	2,000,165	805,055	126,410	59,150	3,716,404	165,260	980,078	195,021	[b] 96,657	[b] 92,054
Omaha	818,003	239,250	....	....	2,414,052	48,501	1,314,841	562,600	[b] 36,391	[b] 34,269
South St. Paul	155,869	102,762	34,466	23,591	617,761	54,749	332,172	207,692	15,151	13,802
Sioux City	307,529	189,445	....	....	959,964	123,332	66,930	19,657	[b] 18,364	[b] 17,397
St. Louis	30,419	2,673	6,523	....	313,716	30,167	11,176	2,424	....	....
National Stock Yards	892,270	224,122	....	....	1,924,206	370,379	520,303	75,015	128,880	97,674
Indianapolis	219,758	90,061	....	....	1,706,679	410,055	131,398	100,693	33,255	27,495
St. Joseph	439,293	81,506	....	....	2,105,209	68,245	525,933	102,257	[b] 22,521	[b] 20,901
Milwaukee	49,722	17,153	38,990	3,951	591,726	3,192	45,322	8,419	2,284	1,571
Pittsburg	139,630	(a)	42,179	(a)	807,824	(c)	471,820	(c)	....	....
Lincoln	70,013	(a)	....	....	15,233	(c)	201,248	(c)	14,011	(c)
Cincinnati	185,812	42,790	44,387	2,600	877,094	330,441	373,073	255,557	....	....
Cleveland	36,871	(a)	3,180	(a)	879,945	428,258	142,806	3,067	....	....
Philadelphia	161,713	21,121	36,500	1,511	194,350	5,910	519,933	41,975	13,976	5,814
Baltimore	151,933	95,231	16,755	2,000	659,694	164,322	387,004	220,639	[b] 7,300	[b] 5,158
East Buffalo	699,094	611,908	15,600	6,300	4,449,920	3,528,480	2,017,400	1,701,800	66,360	59,147
Louisville	98,447	37,868	10,590	815	608,977	228,566	226,711	190,881	2,298	2,022
Detroit	67,443	24,912	13,883	3,465	305,560	25,746	136,018	51,880	907	760
Jersey City	161,870	147,397	73,363	35,281	431,376	(c)	1,369,874	743,927	....	....
New York	316,378	(a)	262,114	(a)	537,605	(c)	673,311	(c)	47,947	2,877
Denver	227,325	191,876	....	....	109,360	2,573	225,555	148,388	[b] 16,545	[b] 15,639
Pueblo	97,387	83,405	....	....	21,546	121	72,776	67,003	[b] 9,396	[b] 8,969
Fort Worth	85,075	64,007	....	....	162,024	3,784	5,567	3,700	[b] 11,587	[b] 9,280
Portland, Oreg	16,915	10,275	....	....	27,330	21,710	63,325	44,635	5,155	1,990
San Francisco	41,613	(a)	5,294	(a)	64,721	(c)	174,381	(c)	....	....
New Brighton, Minn	74,111	74,195	....	....	234	192	153,290	203,569	4,325	4,035
Weehawken, N. J	8,896	8,896	41,036	41,036	183,371	183,371	70,525	70,525	6,967	(c)
Hoboken, N. J	8,224	8,224	47,234	47,234	26,128	26,128	37,019	37,019	575	(c)
Boston	214,320	(a)	104,562	(a)	1,461,921	(c)	509,184	(c)	25,792	(c)
Total	10,807,494	4,205,708	1,104,890	246,321	34,464,424	7,524,444	15,803,068	5,821,635	695,997	523,592

[a] No shipments returned.

[b] Including mules.

[c] Shipments not given in returns.

Receipts and shipments of live stock at leading cities in 1901.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
CHICAGO.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
January	252,445	78,475	8,029	1,111	781,953	104,087	311,053	33,350	9,593	9,113
February	205,467	73,967	6,251	806	784,142	119,627	257,992	54,604	10,619	10,200
March	207,411	80,414	9,620	605	567,969	138,766	243,013	59,647	13,288	13,070
April	252,458	87,932	23,818	1,154	567,491	121,694	320,414	97,688	13,018	11,085
May	253,257	92,114	23,514	1,458	686,958	122,513	313,525	63,264	11,024	10,235
June										
July	282,784	102,355	21,292	1,560	633,730	114,652	355,055	28,092	7,427	6,235
August	275,181	109,426	16,979	2,295	609,568	109,482	345,112	49,198	8,232	8,205
September	298,069	101,447	16,558	2,586	517,895	111,083	448,881	117,047	9,106	8,252
October	297,896	94,558	15,890	2,460	626,839	98,423	446,740	107,401	8,556	8,302
November	231,687	70,341	12,746	2,140	925,523	91,650	386,307	85,752	5,852	5,941
December	249,368	63,415	11,357	1,879	974,456	63,419	341,094	42,058	4,063	3,959
Total	3,081,396	1,031,576	181,824	19,387	8,290,494	1,300,962	4,044,095	763,292	109,353	102,738
KANSAS CITY.										
January	154,724	61,633	3,699	3,140	352,161	1,724	59,058	5,240	[a]15,451	[a]15,960
February	136,419	59,951	3,737	1,625	303,370	7,146	63,529	6,768	9,775	9,250
March	115,285	54,574	3,188	1,250	254,708	8,516	69,565	11,568	6,585	7,045
April	126,459	44,705	3,180	788	297,670	3,855	128,999	32,318	6,673	6,906
May	110,118	34,582	2,965	822	419,558	13,091	103,242	25,009	7,273	7,683
June	122,368	34,484	8,102	2,260	327,540	14,775	79,231	18,506	7,880	6,624
July	232,578	112,085	16,558	5,208	419,876	65,903	72,761	12,148	7,898	7,772
August	217,268	97,593	17,863	6,007	200,955	15,442	63,150	11,060	6,125	4,953
September	231,578	101,693	22,433	9,761	170,557	19,805	91,217	20,838	8,635	7,236
October	270,427	104,220	26,914	16,119	226,559	7,920	117,200	29,759	6,423	6,618
November	158,764	59,816	13,816	8,786	358,442	3,799	84,189	23,217	7,625	6,418
December	124,177	39,769	4,455	3,384	385,018	3,284	47,987	3,595	6,369	5,636
Total	2,000,165	805,055	126,410	59,150	3,716,404	165,260	980,078	195,021	[a]96,657	[a]92,054

OMAHA.										
January	55,456	14,140	......	......	203,477	......	64,282	7,531	[a]2,489	[a]2,120
February	51,763	13,639	......	......	198,571	......	80,184	13,890	2,121	1,795
March	53,824	14,688	......	......	168,580	992	125,095	42,292	1,908	1,853
April	61,377	16,292	......	......	195,102	52	111,516	33,551	2,107	2,090
May	71,991	22,615	......	......	249,818	2,480	86,833	18,920	1,577	1,684
June	47,312	6,708	......	......	204,056	......	43,235	4,595	8,613	7,732
July	53,502	14,135	......	......	235,081	10,651	92,365	30,820	7,032	6,928
August	72,795	18,501	......	......	181,244	4,712	121,559	51,871	1,984	1,920
September	89,608	32,922	......	......	117,336	6,999	159,778	76,802	2,885	2,738
October	109,496	45,063	......	......	150,781	4,521	218,824	154,620	2,008	2,082
November	88,785	27,634	......	......	242,287	4,813	150,114	107,066	2,642	2,337
December	62,184	12,913	......	......	267,724	13,281	61,566	20,642	825	990
Total	818,003	239,250	......	......	2,414,052	48,501	1,314,841	562,600	[a]36,391	[a]34,269
SOUTH ST. PAUL.										
January	11,635	6,641	1,922	859	62,697	3,787	46,015	20,456	234	256
February	11,788	7,299	2,651	2,017	47,183	1,178	9,952	23,242	165	194
March	9,180	6,850	4,057	3,447	45,673	1,743	10,653	8,244	88	83
April	11,230	8,021	6,670	5,249	43,824	1,942	4,753	11,072	245	177
May	10,871	7,001	5,877	5,642	52,278	3,891	2,379	16,541	3,114	2,648
June	8,249	4,353	2,791	1,975	41,057	597	4,380	12,402	3,202	2,978
July	5,270	2,888	2,218	1,308	29,890	826	9,033	4,669	3,665	922
August	11,056	7,152	1,581	698	24,110	996	11,068	3,861	1,445	3,522
September	25,968	19,018	1,735	675	26,468	724	36,024	23,586	583	817
October	24,178	18,833	1,885	589	66,701	7,127	90,705	43,712	2,198	2,449
November	16,595	10,797	1,875	620	87,883	16,046	76,587	23,336	228	289
December	9,552	4,409	1,204	512	89,502	15,892	30,596	11,649	89	22
Total	155,869	102,762	34,466	23,591	617,761	54,749	332,172	207,692	15,151	13,802
SIOUX CITY.										
January	20,367	11,700	......	......	88,185	22,989	6,560	1,202	[a]152	[a]147
February	23,224	13,456	......	......	77,402	13,117	7,636	2,511	2,297	2,281
March	29,191	22,168	......	......	53,420	3,243	3,097	2,223	1,161	996
April	36,017	25,574	......	......	76,020	898	4,175	2,345	313	289

[a] Including mules.

Receipts and shipments of live stock at leading cities in 1901—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
SIOUX CITY—continued.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
May	28,008	23,327	....	....	87,219	18,389	3,536	73	201	185
June	17,426	10,882	....	....	78,443	16,016	2,548	....	3,173	2,789
July	19,506	11,616	....	....	73,253	11,059	2,652	210	3,471	3,252
August	14,957	6,938	....	....	75,030	8,156	4,658	1,466	1,458	1,473
September	27,734	14,505	....	....	52,620	4,643	5,993	477	1,923	1,921
October	42,698	26,484	....	....	79,775	4,793	7,582	3,859	2,327	2,366
November	27,524	14,225	....	....	105,975	8,294	12,492	4,955	1,113	1,024
December	20,877	8,570	....	....	112,622	11,235	6,051	339	775	674
Total	307,529	189,445	....	....	959,964	123,332	66,930	19,657	[a] 18,364	[a] 17,397
ST. LOUIS.										
January	2,632	368	389	....	22,923	406	81	22	....	....
February	1,953	220	336	....	20,264	403	69	17	....	....
March	1,875	225	491	....	33,615	2,851	449	52	....	....
April	2,645	47	640	....	29,506	4,439	657	114	....	....
May	2,395	113	714	....	31,227	4,057	1,483	634	....	....
June	2,262	49	506	....	26,529	1,701	1,178	460	....	....
July	2,992	254	732	....	27,921	3,253	1,668	419	....	....
August	1,883	383	552	....	21,721	2,294	908	109	....	....
September	3,137	243	563	....	23,152	3,869	1,441	103	....	....
October	4,221	480	692	....	24,995	3,680	1,416	394	....	....
November	2,965	164	678	....	26,165	2,084	1,186	100	....	....
December	1,459	127	230	....	25,698	1,130	640	....	....	....
Total	30,419	2,673	6,523	....	313,716	30,167	11,176	2,424	....	....
NATIONAL STOCK YARDS.										
January	58,465	9,786	....	....	190,922	30,994	20,847	1,285	24,483	18,576
February	46,732	7,910	....	....	170,516	28,348	22,119	155	13,258	10,173
March	43,725	6,676	....	....	181,850	37,247	24,425	182	10,599	7,474

April	43,471	6,688	....	....	160,762	89,967	51,551	9,162	8,411	5,417
May	49,133	8,190	....	....	165,513	29,330	57,506	7,810	7,880	6,834
June	71,088	18,626	....	....	129,471	21,195	70,210	21,836	9,094	7,255
July	114,905	44,679	....	....	172,229	53,008	68,425	19,674	11,698	6,846
August	95,067	29,692	....	....	118,494	28,137	51,270	7,441	6,680	5,264
September	101,929	30,889	....	....	134,141	43,713	48,740	4,297	11,314	7,895
October	115,845	31,357	....	....	145,004	23,047	47,777	1,785	10,194	8,139
November	76,051	15,215	....	....	168,192	17,820	31,774	1,233	8,447	5,851
December	72,859	14,261	....	....	187,112	17,390	25,759	205	6,822	5,680
Total	892,270	224,122	....	....	1,924,206	370,379	520,303	75,015	128,880	97,674
INDIANAPOLIS.										
January	16,447	5,149	....	....	178,741	54,792	6,421	5,068	3,627	2,756
February	14,098	4,752	....	....	118,550	41,327	5,084	3,415	2,957	2,920
March	13,590.	4,777	....	....	97,144	28,472	4,802	3,769	3,313	3,007
April	9,290	2,583	....	....	100,338	24,243	2,587	643	3,319	2,382
May	14,560	4,439	....	....	145,825	26,655	4,659	2,651	2,275	2,134
June	15,296	5,557	....	....	147,075	25,186	9,804	6,913	1,763	1,420
July	19,831	9,210	....	....	132,216	43,930	20,638	17,233	3,686	2,770
August	24,775	12,077	....	....	147,808	49,314	16,619	13,293	2,675	2,269
September	26,167	11,866	....	....	76,022	18,283	18,412	14,081	2,709	2,178
October	25,446	10,204	....	....	142,378	26,874	21,165	15,968	3,255	2,553
November	19,976	9,679	....	....	221,090	34,413	11,391	9,595	2,215	1,788
December	20,282	9,768	....	....	199,492	36,566	9,816	8,064	1,461	1,318
Total	219,758	90,061	....	....	1,706,679	410,055	131,398	100,693	33,255	27,495
ST. JOSEPH.										
January	24,991	5,670	....	....	164,290	152	19,610	270	*1,362	*1,042
February	22,984	5,065	....	....	147,350	....	24,894	2,311	1,310	1,010
March	24,366	7,070	....	....	121,408	446	49,482	10,926	2,044	1,699
April	26,018	4,652	....	....	134,285	138	78,975	18,289	1,272	1,371
May	32,400	5,086	....	....	185,038	114	74,020	11,152	1,953	1,832
June	27,088	4,715	....	....	192,301	495	39,223	2,364	4,569	4,283
July	43,902	10,921	....	....	249,756	30,333	33,869	2,860	4,486	4,238
August	54,737	12,008	....	....	177,539	11,114	36,435	8,036	1,615	1,641

*Including mules.

Receipts and shipments of live stock at leading cities in 1901—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments
ST. JOSEPH—continued.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
September	49,693	9,113	....	....	122,647	3,376	65,058	17,565	1,742	1,749
October	54,540	8,191	....	....	151,709	3,858	59,810	16,453	933	811
November	44,248	5,287	....	....	225,780	9,484	33,775	11,329	759	818
December	34,326	3,728	....	....	233,106	8,735	9,782	702	476	405
Total	439,293	81,506	....	....	2,105,209	68,245	525,933	102,257	*22,521	*20,899
MILWAUKEE.										
January	5,410	2,578	2,087	115	70,297	377	3,615	2,201	114	86
February	3,711	1,038	2,133	188	52,591	889	2,469	374	150	64
March	3,523	1,247	2,464	259	32,057	....	1,611	80	174	145
April	3,771	944	4,768	798	43,678	130	1,382	....	299	185
May	4,034	943	5,416	435	50,379	....	1,731	124	184	44
June	3,716	1,124	4,611	178	43,159	....	3,873	1,085	323	176
July	3,314	714	5,210	895	39,602	....	5,164	....	334	262
August	4,268	1,394	3,562	759	30,506	5	6,110	827	302	287
September	5,114	2,038	2,291	113	29,464	172	6,144	988	127	126
October	4,676	2,251	2,420	87	65,756	257	5,542	886	85	70
November	4,215	1,731	1,910	83	65,070	....	4,184	793	150	103
December	8,970	1,151	2,118	41	69,167	1,362	8,497	1,061	42	23
Total	49,722	17,153	38,990	8,951	591,726	3,192	45,322	8,419	2,284	1,571
PITTSBURG.										
January	10,074	....	1,271	....	77,710	....	42,923	....	....	....
February	9,985	....	1,565	....	53,797	....	30,417	....	....	....
March	7,241	....	2,604	....	44,774	....	21,727	....	....	....
April	10,510	....	7,259	....	51,824	....	20,407	....	....	....
May	7,677	....	7,637	....	68,332	....	44,136	....	....	....
June	8,834	....	4,260	....	58,485	....	38,382	....	....	....
July	13,764	....	4,202	....	51,078	....	48,304	....	....	....

August	10,815	......	3,154	......	57,194	......	40,401	......	......	......
September	16,765	......	2,989	......	60,126	......	46,174	......	......	......
October	15,348	......	3,188	......	79,142	......	42,316	......	......	......
November	14,523	......	2,116	......	106,290	......	40,544	......	......	......
December	14,394	......	1,934	......	104,072	......	50,089	......	......	......
Total	139,630	......	42,179	......	807,824	......	471,820	......	......	......
LINCOLN.										
January	2,576	......	......	......	571	......	5,623	......	872	......
February	2,524	......	......	......	654	......	4,072	......	774	......
March	3,898	......	......	......	1,615	......	4,656	......	924	......
April	2,041	......	......	......	826	......	49,840	......	524	......
May	1,263	......	......	......	2,129	......	36,286	......	958	......
June	308	......	......	......	1,608	......	12,630	......	1,188	......
July	6,676	......	......	......	1,502	......	5,630	......	1,558	......
August	9,138	......	......	......	2,291	......	8,578	......	2,033	......
September	9,810	......	......	......	970	......	15,958	......	1,220	......
October	15,458	......	......	......	1,605	......	21,698	......	1,731	......
November	16,201	......	......	......	784	......	28,105	......	1,248	......
December	8,030	......	......	......	728	......	3,140	......	986	......
Total	70,013	......	......	......	15,233	......	201,248	......	14,011	......
CINCINNATI.										
January	13,967	2,941	3,860	17	96,560	38,853	9,807	3,711	......	......
February	11,170	1,463	2,731	42	71,850	27,522	6,826	2,199	......	......
March	11,890	1,540	3,650	38	64,516	27,638	5,119	554	......	......
April	14,378	2,007	4,726	43	66,741	25,266	6,678	587	......	......
May	16,804	3,343	5,171	117	73,175	29,169	14,765	4,668	......	......
June	14,822	3,819	3,790	29	61,391	22,675	58,439	48,881	......	......
July	16,694	4,182	3,527	135	52,710	15,833	103,664	79,952	......	......
August	15,900	4,093	3,753	512	59,520	21,059	73,927	66,231	......	......
September	18,607	4,248	3,782	589	48,607	18,768	37,626	23,428	......	......
October	20,941	6,975	3,612	595	70,809	28,023	24,663	11,432	......	......
November	16,093	5,056	2,929	333	105,459	36,965	17,775	8,431	......	......
December	15,046	3,123	2,856	150	105,756	38,670	14,084	5,988	......	......
Total	185,812	42,790	44,387	2,600	877,094	330,441	373,073	255,557	......	......

* Including mules.

Receipts and shipments of live stock at leading cities in 1901—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
CLEVELAND.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
January	3,882	....	119	....	82,544	43,090	12,902	267	....	....
February	3,302	....	132	....	48,658	20,750	13,142	421	....	....
March	4,034	....	223	....	53,453	23,160	11,900	816	....	....
April	5,323	....	153	....	57,743	24,803	9,278	....	....	....
May	4,133	....	512	....	83,869	45,690	12,365	381	....	....
June	3,039	....	351	....	74,935	30,353	11,717	448	....	....
July	2,330	....	194	....	53,192	25,362	11,108	....	....	....
August	1,549	....	280	....	62,531	32,253	12,040	....	....	....
September	1,226	....	358	....	48,194	22,370	10,594	178	....	....
October	2,039	....	268	....	83,130	34,843	11,897	....	....	....
November	2,383	....	312	....	121,800	64,419	12,348	402	....	....
December	3,631	....	278	....	109,896	61,165	13,515	154	....	....
Total	36,871	....	3,180	....	879,945	428,258	142,806	3,067	....	....
PHILADELPHIA.										
January	12,673	1,649	2,260	....	19,841	967	32,571	2,405	44	535
February	13,313	2,053	2,475	37	18,052	759	30,353	2,973	73	712
March	11,402	2,082	2,880	38	15,255	419	28,292	1,648	77	537
April	15,464	1,456	2,940	25	20,054	124	41,953	1,589	20	519
May	14,447	2,259	4,100	54	15,414	88	35,462	2,402	2	467
June	14,694	1,435	3,120	182	14,216	84	39,176	3,080	13,739	299
July	14,882	1,243	3,458	43	12,828	200	50,702	5,515	4	322
August	12,130	1,783	3,560	61	11,502	51	48,543	7,947	....	241
September	15,641	1,563	3,289	417	15,923	161	61,657	6,170	....	462
October	12,835	2,247	3,474	421	14,982	806	51,519	3,944	17	618
November	12,366	2,046	2,753	166	16,374	1,943	50,861	1,948	....	725
December	11,866	1,305	2,191	67	19,909	308	48,844	2,354	....	377
Total	161,713	21,121	36,500	1,511	194,350	5,910	519,933	41,975	13,976	5,814

BALTIMORE.										
January	12,291	7,047	1,200	95	67,153	21,116	20,712	8,529	[a]946	[a]855
February	8,579	5,551	1,403	15	58,150	14,835	17,520	9,626	907	684
March	9,547	5,168	1,299	111	61,168	15,987	18,743	7,479	1,250	467
April	9,227	5,305	2,282	78	58,389	18,125	18,760	8,343	424	389
May	10,023	5,353	2,479	147	53,704	12,674	25,394	11,546	380	237
June	9,012	5,564	1,300	169	50,025	11,318	39,812	22,945	297	201
July	10,068	5,984	878	202	43,079	9,018	42,464	30,168	91	53
August	10,906	6,877	748	287	47,091	8,778	49,649	34,846	364	208
September	18,623	12,223	1,364	494	45,902	11,157	57,304	29,837	618	473
October	22,332	14,798	1,608	242	55,069	13,762	40,081	14,481	819	624
November	17,624	12,255	1,200	113	60,568	14,632	32,054	19,529	404	302
December	13,701	9,106	994	47	59,396	12,920	24,511	13,310	800	665
Total	151,933	95,231	16,755	2,000	659,694	164,322	387,004	220,639	[a]7,300	[a]5,158
EAST BUFFALO.										
January	55,880	53,152	1,400	400	464,800	355,680	205,600	198,800	4,840	4,389
February	53,636	50,336	1,500	700	348,800	280,000	172,800	160,200	5,400	4,959
March	58,476	52,426	1,500	500	313,120	237,760	214,800	183,000	9,500	8,037
April	52,030	46,662	1,400	600	320,640	250,240	178,000	170,400	8,360	6,422
May	60,412	56,122	900	400	385,280	299,040	178,600	155,400	7,800	7,372
June	81,620	52,382	1,200	400	354,560	281,760	109,200	80,200	6,300	7,239
July	56,716	52,162	1,000	500	321,920	263,840	94,000	67,000	3,800	3,363
August	57,530	52,602	1,100	600	352,480	294,400	100,200	82,600	5,480	4,161
September	60,062	53,988	1,700	500	332,320	248,000	150,000	132,200	5,140	4,769
October	56,474	51,524	1,400	600	382,080	289,760	154,200	154,400	5,360	4,826
November	54,648	49,258	1,400	700	510,560	412,000	178,600	152,000	3,140	2,546
December	51,590	41,294	1,100	400	363,360	316,000	281,400	165,600	1,240	1,064
Total	699,094	611,908	15,600	6,300	4,449,920	3,528,480	2,017,400	1,701,800	66,360	59,147
LOUISVILLE.										
January	8,038	2,820	662	22	72,263	41,306	2,142	1,182	294	212
February	8,210	2,106	694	109	53,460	26,971	1,547	518	243	228
March	6,637	2,824	975	32	48,780	25,173	2,083	751	437	397
April	5,354	1,336	1,083	....	45,414	16,460	3,664	2,819	144	61

[a] Includes mules.

Receipts and shipments of live stock at leading cities in 1901—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
LOUISVILLE—continued.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
May	5,760	1,689	989	20	52,818	17,286	19,931	14,428	87	85
June	7,627	3,341	854	15	35,708	9,040	60,844	56,915	54	49
July	8,148	7,824	919	73	36,247	5,768	66,225	59,612	368	378
August	5,232	1,946	1,052	130	35,322	9,800	87,540	33,141	279	269
September	10,875	3,450	1,005	175	38,692	13,587	20,738	15,494	111	103
October	11,822	6,836	900	47	55,235	24,910	6,484	3,311	166	146
November	9,701	4,939	794	144	72,618	19,678	8,959	2,663	50	45
December	11,043	8,757	713	48	62,935	19,092	1,609	547	65	49
Total	98,447	37,868	10,590	815	608,977	228,566	226,711	190,881	2,298	2,022
DETROIT.										
January	4,282	1,274	1,028	382	23,682	1,532	11,075	5,174	....	....
February	4,237	1,601	758	188	18,503	1,193	11,251	5,599	....	....
March	4,388	2,157	894	246	22,023	2,008	13,178	7,735	....	....
April	7,174	3,226	1,693	372	33,077	3,447	12,480	3,017	1	....
May	5,994	3,905	1,522	403	24,240	1,498	10,011	6,572	2	....
June	5,919	2,579	1,116	59	24,092	626	6,988	1,487	2	2
July	6,469	2,599	1,238	96	23,863	1,412	7,456	507	38	10
August	4,901	1,193	866	110	17,560	500	9,042	2,684	24	24
September	6,714	1,994	1,366	337	30,613	8,847	14,139	5,116	272	269
October	5,912	1,649	1,278	378	21,158	2,445	12,896	8,334	318	277
November	5,612	1,473	1,183	520	32,766	5,564	18,926	4,849	285	158
December	5,841	1,262	996	374	38,988	2,174	14,182	5,806	20	20
Total	67,443	24,912	13,883	3,465	305,560	25,746	186,018	51,880	907	700
JERSEY CITY.										
January	16,430	14,929	4,910	2,962	52,384	....	87,540	37,025	....	....
February	15,370	14,009	5,119	3,702	36,760	....	92,598	52,025	....	....

March	9,500	8,415	5,772	3,404	30,890		77,310	88,927		
April	9,620	8,337	8,660	2,479	29,340		67,418	32,664		
May	9,897	8,041	9,180	1,297	25,920		82,316	34,030		
June	10,940	9,699	7,940	2,455	19,216		155,430	104,559		
July	10,565	9,410	6,790	3,944	20,316		153,320	90,206		
August	11,120	10,097	7,134	4,422	36,740		162,316	97,567		
September	16,890	15,274	5,470	3,864	38,260		151,486	88,176		
October	17,760	16,590	5,610	3,445	40,700		144,360	80,954		
November	17,388	16,208	3,718	2,090	47,490		109,460	53,091		
December	16,900	16,298	3,060	1,657	53,360		86,370	34,103		
Total	161,870	147,897	73,363	35,281	431,376		1,369,874	743,927		
NEW YORK.										
January	27,089		9,090		53,345		76,794		3,684	32
February	25,644		10,458		44,731		69,736		3,541	72
March	28,384		22,231		57,645		83,345		4,780	176
April	22,211		30,798		40,326		61,755		5,466	161
May	28,404		47,445		42,252		59,697		5,085	300
June	24,315		34,682		40,098		10,330		3,621	441
July	25,454		24,146		38,568		7,285		3,503	223
August	27,450		26,521		31,625		17,057		3,366	99
September	26,803		16,556		41,090		58,860		4,779	248
October	26,200		15,470		38,769		66,665		3,950	278
November	30,493		15,930		48,809		91,958		8,421	568
December	23,931		8,787		60,347		69,829		2,751	179
Total	316,378		962,114		537,605		673,311		47,947	2,877
DENVER.										
January	12,334	9,384			13,143	171	8,793	3,297	*593	*534
February	5,761	4,258			10,430	152	8,200	3,699	1,236	1,179
March	8,964	6,926			7,222	177	8,083	3,000	616	601
April	8,536	5,313			11,389	276	9,858	3,948	588	565
May	50,538	46,115			8,678	107	7,602	1,832	1,239	1,120
June	46,429	46,299			8,431	145	4,105	191	3,056	2,966
July	19,628	15,420			8,350	174	9,020	3,071	2,412	2,226

* Includes mules.

Receipts and shipments of live stock at leading cities in 1901—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
DENVER—continued.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
August	13,599	10,162	....	....	6,576	330	15,697	7,719	1,151	1,113
September	13,011	9,579	....	....	7,912	390	21,904	11,042	1,934	1,780
October	19,279	15,418	....	....	9,942	173	52,022	45,360	1,059	987
November	17,998	14,745	....	....	8,121	320	64,357	49,346	838	842
December	11,248	8,257	....	....	9,166	158	15,914	15,883	1,823	1,726
Total	227,325	191,876	....	....	109,360	2,573	225,555	148,388	[a]16,545	[a]15,639
PUEBLO.										
January	2,029	1,696	....	....	2,344	....	889	....	[a]694	[a]694
February	453	330	....	....	1,455	....	466	205	468	464
March	617	498	....	....	1,524	....	393	....	634	634
April	1,215	926	....	....	1,857	6	489	229	179	178
May	31,093	28,708	....	....	1,440	....	425	....	674	567
June	28,537	26,089	....	....	1,626	44	277	....	2,806	2,804
July	11,704	8,151	....	....	2,004	....	1,824	1,498	1,701	1,665
August	4,591	3,057	....	....	1,669	....	2,904	2,283	456	351
September	7,114	6,267	....	....	1,991	....	22,490	21,938	453	286
October	5,525	4,772	....	....	1,901	....	33,450	28,645	488	533
November	3,346	1,988	....	....	2,251	71	8,497	10,642	787	737
December	1,163	923	....	....	1,484	....	672	1,563	56	56
Total	97,387	83,405	....	....	21,546	121	72,776	67,003	[a]9,396	[a]8,969
FORT WORTH.										
January	3,859	1,647	....	....	18,391	322	14	....	[a]419	[a]312
February	4,249	977	....	....	15,209	419	105	....	399	268
March	4,859	2,506	....	....	23,186	227	452	....	149	259
April	16,360	13,409	....	....	22,116	710	148	313	163	134
May	19,855	18,297	....	....	15,205	903	855	....	1,085	1,720

June	6,772	5,339	....	....	7,339	455	778	607	2,876	653
July	2,402	968	....	....	10,188	172	2,757	2,616	1,747	838
August	2,337	1,092	....	....	10,105	145	357	....	709	1,133
September	3,356	2,106	....	....	11,595	....	69	....	1,342	1,571
October	4,801	3,343	....	....	11,441	203	360	164	625	263
November	8,978	6,933	....	....	8,069	71	110	....	1,521	997
December	8,247	7,391	....	....	9,180	157	62	....	461	1,132
Total	85,075	64,007	....	....	162,024	3,784	5,567	3,700	[*]11,587	[*]9,280
PORTLAND, OREG.										
January	1,115	760	....	....	1,680	1,305	3,065	1,630	110	95
February	850	500	....	....	710	215	2,865	2,100	460	75
March	1,150	840	....	....	2,220	1,275	4,030	2,230	1,350	495
April	1,710	1,345	....	....	1,735	995	5,545	4,795	585	185
May	1,795	1,375	....	....	1,825	1,820	10,630	9,770	155	135
June	2,795	1,255	....	....	1,405	1,055	8,665	7,440	1,470	340
July	1,285	1,110	....	....	1,260	1,090	5,130	3,345	100	80
August	1,235	405	....	....	1,375	1,150	3,000	2,545	275	200
September	1,585	520	....	....	3,225	2,405	3,950	3,630	210	125
October	775	320	....	....	3,065	2,100	4,155	1,680	200	145
November	1,235	625	....	....	4,655	4,635	3,900	2,150	100	25
December	1,385	1,220	....	....	4,175	3,665	8,390	3,320	140	90
Total	16,915	10,275	....	....	27,330	21,710	63,325	44,635	5,155	1,990
SAN FRANCISCO.										
January	3,744	....	370	....	5,325	....	14,476	....	....	....
February	3,568	....	234	....	3,357	....	10,237	....	....	....
March	3,630	....	188	....	4,458	....	15,208	....	....	....
April	3,141	....	261	....	4,166	....	12,326	....	....	....
May	3,107	....	415	....	4,500	....	13,869	....	....	....
June	2,932	....	453	....	3,264	....	16,593	....	....	....
July	3,185	....	519	....	3,194	....	14,920	....	....	....
August	3,230	....	599	....	4,840	....	17,100	....	....	....
September	3,766	....	534	....	7,022	....	13,261	....	....	....
October	4,433	....	615	....	9,020	....	14,739	....	....	....

[*] Includes mules.

Receipts and shipments of live stock at leading cities in 1901—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
SAN FRANCISCO—continued.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
November	3,536		490		7,448		16,733			
December	3,341		616		8,127		14,919			
Total	41,613		5,294		64,721		174,381			
NEW BRIGHTON, MINN.										
January							18,156	29,955	79	79
February	19						5,586	13,486	390	388
March	189	187					819	23,003	102	79
April					33	33	2,640	21,050	22	19
May		214						9,850	152	105
June	15							8,238	120	120
July	864	916			58	58	1,151	1,151	791	780
August	16,618	16,618					6,896	6,676	883	814
September	22,817	22,795			113	71	20,081	20,081	614	570
October	24,808	24,770					48,672	42,072	959	887
November	8,021	7,969			30	30	41,983	22,729	158	139
December	757	726					7,306	5,278	55	55
Total	74,111	74,195			234	192	158,290	203,569	4,325	4,035
WEEHAWKEN.										
January	1,348	1,348	2,614	2,614	16,823	16,823	10,657	10,657	838	
February	495	495	2,702	2,702	16,043	16,043	3,374	3,374	634	
March	380	380	2,958	2,958	15,758	15,758	4,947	4,947	1,144	
April	585	585	4,709	4,709	14,713	14,713	2,848	2,848	581	
May	604	604	4,933	4,933	13,804	13,804	3,858	3,858	809	
June	518	518	4,856	4,856	14,714	14,714	312	312	855	
July	477	477	4,257	4,257	12,471	12,471	324	324	331	
August	487	487	3,301	3,301	12,181	12,181	1,897	1,897	565	

September	923	923	3,258	3,258	14,839	14,839	8,308	8,308	252	
October	1,479	1,479	3,241	3,241	15,848	15,848	7,469	7,469	540	
November	1,141	1,141	2,306	2,306	18,758	18,758	12,744	12,744	206	
December	456	456	1,901	1,901	17,419	17,419	13,787	13,787	212	
Total	8,896	8,896	41,036	41,036	183,371	183,371	70,525	70,525	6,967	
HOBOKEN, N. J.										
January	590	590	1,746	1,746	2,662	2,662	3,459	3,459	92	
February	762	762	3,002	3,002	3,166	3,166	2,889	2,889	71	
March	788	788	4,470	4,470	4,387	4,387	5,058	5,058	114	
April	537	537	7,457	7,457	3,538	3,538	2,469	2,469	104	
May	706	706	8,496	8,496	3,043	3,043	2,780	2,780	68	
June	730	730	7,292	7,292	2,224	2,224	529	529		
July	824	824	5,045	5,045	1,975	1,975	538	538		
August	700	700	2,816	2,816	247	247	1,166	1,166	44	
September	819	819	1,934	1,931	414	414	4,936	4,936	42	
October	949	949	2,331	2,331	937	937	4,711	4,711	15	
November	579	579	1,937	1,937	2,004	2,004	4,836	4,836	25	
December	240	240	708	708	1,531	1,531	3,648	3,648		
Total	8,224	8,224	47,234	47,234	26,128	26,128	37,019	37,019	575	
BOSTON.										
January	19,692		5,709		149,245		43,627			
February	15,201		6,841		96,037		51,378			
March	19,169		9,299		105,064		51,857			
April	18,025		12,711		122,372		28,136			
May	20,009		14,351		129,333		34,517			
June	17,432		10,954		113,332		30,350			
July	13,780		9,378		122,940		33,770			
August	14,854		7,177		122,425		30,185			
September	16,835		6,942		108,426		47,477			
October	20,642		9,185		110,364		49,896			
November	19,415		7,158		154,312		58,950			
December	19,266		4,854		128,071		49,041			
Total	214,320		104,562		1,461,921		509,184		25,792	

Average weight of cattle at Chicago for seven years, by months.

[From Yearbook of Figures, by Chicago Daily Drovers' Journal.]

Month.	1901.	1900.	1899.	1898.	1897.	1896.	1895.
January	1,096	1,097	1,097	1,111	1,121	1,136	1,070
February	1,105	1,104	1,111	1,111	1,125	1,175	1,101
March	1,081	1,096	1,118	1,111	1,126	1,172	1,052
April	1,041	1,088	1,071	1,086	1,080	1,150	1,038
May	1,036	1,061	1,050	1,099	1,088	1,134	1,030
June	1,000	1,068	1,051	1,091	1,072	1,118	1,011
July	1,021	1,086	1,080	1,065	1,066	1,105	1,033
August	1,024	1,067	1,039	1,064	1,045	1,112	1,049
September	1,011	1,060	1,017	1,062	1,086	1,096	1,071
October	1,000	1,061	1,035	1,039	1,081	1,062	1,054
November	988	1,057	1,027	1,087	1,097	1,081	1,060
December	1,018	1,103	1,041	1,109	1,122	1,096	1,078
Total	1,035	1,078	1,061	1,086	1,091	1,118	1,051

Average weight of sheep and lambs at Chicago for thirteen years, by months.

[From Yearbook of Figures, by Chicago Daily Drovers' Journal.]

Month.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.	1893.	1892.	1891.	1890.	1889.
January	90	90	90	92	91	95	93	93	90	93	94	95	[illegible]
February	94	90	88	91	89	96	94	94	92	93	95	95	99
March	94	92	84	89	88	95	96	91	92	95	94	96	97
April	90	88	88	89	82	90	93	92	88	89	91	89	[illegible]
May	88	87	87	87	84	85	87	80	85	82	90	85	[illegible]
June	84	81	82	81	82	79	82	83	82	81	86	82	[illegible]
July	79	78	79	79	81	83	78	83	83	83	82	85	[illegible]
August	78	80	77	79	83	83	86	83	84	86	87	89	[illegible]
September	78	76	80	78	85	83	85	84	88	88	82	91	[illegible]
October	80	77	80	84	83	85	89	83	89	86	81	96	[illegible]
November	79	79	82	84	88	91	89	88	88	86	86	91	[illegible]
December	85	89	78	93	90	91	90	92	93	91	90	96	[illegible]
Total	85	84	82	86	85	88	88	89	85	86	88	90	[illegible]

Average weight of hogs for a series of years, by months, at leading cities

[From Yearbook of Figures, by Chicago Daily Drovers' Journal.]

CHICAGO.

Month.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.	1893.
January	227	229	231	233	247	236	223	251	[illegible]
February	224	226	229	227	238	239	220	234	[illegible]
March	222	223	232	229	230	246	222	232	[illegible]
April	226	223	231	223	235	243	226	226	[illegible]
May	227	228	232	225	237	243	227	227	[illegible]
June	231	229	236	229	240	249	225	233	[illegible]
July	229	236	237	232	238	249	233	226	[illegible]
August	238	246	244	243	249	253	237	224	[illegible]
September	248	247	250	246	252	257	242	232	[illegible]
October	236	334	240	236	244	242	230	232	[illegible]
November	218	240	250	235	252	245	241	[illegible]	[illegible]
December	202	238	243	239	245	254	243	229	[illegible]
Total	226	233	237	234	242	246	230	233	[illegible]

Average weight of hogs for a series of years, by months, at leading cities—Continued.

KANSAS CITY.

Month.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.
January	213	230	216	218	224	238	216	226
February	210	218	207	212	225	231	213	220
March	207	210	208	211	216	232	213	216
April	207	207	209	209	216	226	213	211
May	210	213	213	209	217	222	211	212
June	205	213	209	210	220	221	212	209
July	187	206	211	217	219	214	213	215
August	187	219	211	219	217	216	209	199
September	185	214	211	218	218	226	212	203
October	199	213	215	215	210	229	220	208
November	179	216	230	211	221	238	227	220
December	173	218	222	208	217	232	235	221
Total	197	215	213	213	218	227	216	215

SIOUX CITY.

Month.	1901.	1900.	1899.	1898.	1897.	1896.	1895.
January	243	254	283	273	281	264	192
February	239	260	257	252	254	258	190
March	238	243	260	254	249	261	200
April	240	244	263	258	264	261	210
May	241	244	263	255	267	271	219
June	245	244	264	262	269	274	226
July	243	242	260	266	270	270	234
August	251	257	260	269	271	267	236
September	262	267	275	286	274	281	237
October	268	274	291	292	281	289	233
November	268	280	296	295	288	285	250
December	231	266	280	299	280	289	266
Total	249	258	272	271	278	274	224

OMAHA.

Month.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.
January	234	257	262	287	275	275	194	259
February	231	237	245	263	269	268	199	245
March	232	243	247	260	269	261	211	238
April	232	236	247	260	269	262	217	242
May	234	237	251	257	271	268	217	240
June	242	239	250	260	272	273	222	238
July	231	234	248	263	269	272	226	234
August	236	239	246	259	270	272	219	208
September	246	249	256	265	274	282	238	196
October	250	245	259	274	286	288	246	210
November	235	253	270	279	290	289	261	219
December	212	252	268	274	299	291	269	197
Total	235	243	254	266	276	275	227	[illegible]

Highest and lowest prices of pork, by years, from 1862 to 1867, and by years and months from 1888 to 1901.

[From Yearbook of Figures, by Chicago Daily Drovers' Journal.]

Year.	Range of prices.		Year.	Range of prices.	
	Lowest.	Highest.		Lowest.	Highest.
1862	$8.00	$12.25	1890:		
1863	10.00	18.50	January	$9.10	$10.00
1864	17.50	44.00	February	9.65	9.90
1865	22.50	38.00	March	9.80	10.62½
1866	17.00	34.00	April	10.50	13.62½
1867	18.00	24.50	May	11.75	13.87½
1868	19.62½	30.00	June	12.00	13.25
1869	27.00	34.00	July	11.00	12.50
1870	18.00	30.50	August	10.10	12.00
1871	12.00	23.00	September	9.25	10.45
1872	11.05	16.00	October	9.55	10.50
1873	11.00	18.00	November	8.62½	10.25
1874	13.75	24.75	December	7.50	8.87½
1875	17.70	23.50	1891:		
1876	15.20	22.75	January	9.50	10.75
1877	11.40	17.95	February	9.25	9.75
1878	6.02½	11.35	March	9.60	12.62½
1879	7.27½	13.75	April	12.12½	12.90
1880	9.37½	19.00	May	10.55	13.00
1881	12.40	20.00	June	9.75	10.62½
1882	16.00	24.75	July	10.00	11.62½
1883	10.20	20.15	August	9.87½	11.40
1884	10.55	19.50	September	9.80	11.10
1885	8.00	13.25	October	8.25	10.12½
1886	8.20	12.20	November	8.20	8.80
1887	11.60	24.00	December	7.45	8.62½
1888:			1892:		
January	13.75	15.37½	January	10.37½	11.87½
February	13.55	14.50	February	11.02½	11.87½
March	13.12½	14.10	March	9.85	11.37½
April	13.20	14.30	April	9.25	10.30
May	13.60	14.50	May	9.35	10.85
June	13.40	14.15	June	10.20	11.50
July	13.10	14.75	July	11.15	12.30
August	13.20	14.87½	August	10.05	13.25
September	14.00	15.35	September	9.95	11.30
October	14.50	16.00	October	10.75	12.35
November	13.37½	15.00	November	11.25	13.87½
December	12.90	13.87½	December	13.70	15.05
1889:			1893:		
January	11.50	13.37½	January	16.25	19.87½
February	10.87½	11.62½	February	17.87½	19.70
March	11.12½	12.87½	March	16.92½	18.65
April	11.35	12.50	April	15.75	19.35
May	11.40	12.12½	May	18.80	21.00
June	11.50	11.90	June	18.75	21.62½
July	10.50	11.75	July	18.20	19.77½
August	9.45	10.75	August	10.25	18.50
September	10.25	11.60	September	15.00	17.65
October	9.50	11.00	October	16.95	18.00
November	9.05	10.00	November	12.75	17.50
December	8.35	9.60	December	12.80	13.25

Highest and lowest prices of pork, by years, from 1862 to 1867, and by years and months from 1888 to 1901—Continued.

Year.	Range of prices.	
	Lowest.	Highest.
1894:		
January	$12.52½	$13.67½
February	11.82½	12.92½
March	10.67½	11.85
April	11.37½	13.30
May	11.70	12.52½
June	11.65	12.62½
July	12.37½	12.87½
August	12.75	14.00
September	13.00	14.57½
October	11.87½	13.62½
November	11.87½	12.75
December	11.25	12.37½
1895:		
January	9.42½	11.75
February	9.62½	10.37½
March	10.15	12.62½
April	11.87½	12.60
May	11.75	12.87½
June	11.70	12.65
July	10.00	12.30
August	9.00	10.10
September	8.00	9.00
October	8.00	8.65
November	7.75½	8.37
December	7.50½	8.12
1896:		
January	8.62½	10.85
February	9.50	10.67½
March	8.25	9.85
April	8.05	8.75
May	6.95	8.10
June	6.85	7.20
July	5.95	6.90
August	5.50	7.20
September	5.55	6.15
October	6.35	7.50
November	6.30	7.20
December	6.50	7.00
1897:		
January	7.55	8.00
February	7.45	8.00
March	7.95	8.90
April	8.05	8.60
May	7.95	8.70
June	7.30	7.95
July	7.40	7.95
August	7.70	8.95
September	8.05	9.00
October	7.50	8.20
November	7.20	7.70
December	7.15	7.97½
1898:		
January	$9.00	$10.00
February	9.75	11.75
March	9.35	10.65
April	9.55	11.45
May	10.75	12.30
June	9.40	11.20
July	9.30	10.05
August	8.55	9.45
September	8.00	8.85
October	7.65	8.10
November	7.75	8.05
December	7.90	9.00
1899:		
January	9.70	10.45
February	9.20	10.25
March	8.75	9.35
April	8.90	9.25
May	7.85	8.85
June	7.95	8.32½
July	8.15	9.20
August	8.15	8.60
September	7.90	8.25
October	7.85	8.25
November	7.95	8.30
December	8.00	9.15
1900:		
January	10.35	10.90
February	10.50	11.10
March	10.50	12.75
April	12.45	13.25
May	11.20	12.10
June	11.05	12.85
July	11.55	12.75
August	10.90	12.20
September	10.85	12.30
October	12.60	16.00
November	10.37½	11.50
December	11.00	11.62½
1901:		
January	12.60	15.00
February	13.77½	14.15
March	13.90	16.80
April	14.10	15.55
May	14.45	15.20
June	14.50	14.90
July	13.75	14.60
August	13.70	14.50
September	14.35	15.05
October	13.40	14.65
November	13.75	15.25
December	15.10	16.10

Highest and lowest prices of lard, by years, from 1862 to 1887, and by years and month from 1888 to 1901.

[From Yearbook of Figures, by Chicago Daily Drovers' Journal.]

Year.	Range of prices.		Year.	Range of prices.	
	Lowest.	Highest.		Lowest.	Highest
1862	$5.75	$9.75	1890:		
1863	7.25	12.00	January	$5.77½	$5.97
1864	11.75	23.50	February	5.70	5.85
1865	16.00	30.00	March	5.82½	6.20
1866	11.25	23.00	April	6.07½	6.52
1867	11.25	13.75	May	6.00	6.40
1868	11.75	19.50	June	5.62½	5.97
1869	16.25	29.75	July	5.62½	6.15
1870	11.00	17.25	August	5.97½	6.27
1871	8.37½	13.00	September	6.00	6.30
1872	7.00	11.00	October	6.15	6.45
1873	6.50	9.37	November	5.70	6.32
1874	8.20	15.50	December	5.50	5.92
1875	11.80	15.75	1891:		
1876	9.55	13.85	January	5.65	6.00
1877	7.55	11.55	February	5.47½	5.90
1878	5.32½	7.80	March	5.62½	6.87½
1879	5.30	7.75	April	6.45	6.90
1880	6.35	7.85	May	6.20	6.75
1881	9.20	13.00	June	5.95	6.30
1882	10.05	13.10	July	6.07½	6.75
1883	7.15	12.10	August	6.40	6.65
1884	6.45	10.00	September	6.57½	7.05
1885	5.82½	7.10	October	5.85	6.82½
1886	5.82½	7.50	November	5.85	6.32½
1887	6.20	7.92½	December	5.90	6.17½
1888:			1892:		
January	7.25	7.87½	January	6.05	[illegible]
February	7.52½	7.87½	February	6.35	6.57½
March	7.45	7.75	March	6.15	[illegible]
April	7.47½	8.20	April	6.12½	[illegible]
May	7.92½	8.70	May	6.12½	[illegible]
June	4.65	8.02½	June	6.30	[illegible]
July	7.95	9.00	July	6.90	[illegible]
August	8.60	9.52½	August	7.27½	8.15
September	9.52½	10.92½	September	7.20	[illegible]
October	8.12½	11.20	October	8.10	8.90
November	8.12½	8.55	November	8.35	10.50
December	7.60	8.42½	December	9.25	[illegible]
1889:			1893:		
January	6.75	7.55	January	10.50	[illegible]
February	6.50	7.00	February	11.20	[illegible]
March	6.65	7.10	March	10.42½	[illegible]
April	6.77½	7.02½	April	9.40	[illegible]
May	6.65	6.95	May	9.95	[illegible]
June	6.42½	6.70	June	9.35	[illegible]
July	6.00	6.47½	July	9.20	[illegible]
August	5.92½	6.42½	August	6.00	[illegible]
September	5.92½	6.20	September	7.95	[illegible]
October	6.00	6.85	October	9.30	[illegible]
November	5.87½	6.20	November	8.07½	[illegible]
December	5.75	6.00	December	[illegible]	[illegible]

Highest and lowest prices of lard, by years, from 1862 to 1887, and by years and months from 1888 to 1901—Continued.

Year.	Range of prices.		Year.	Range of prices.	
	Lowest.	Highest.		Lowest.	Highest.
1894:			1898:		
January	$7.50	$8.35	January	$4.62½	$4.87½
February	7.20	7.65	February	4.72½	5.27½
March	6.45	7.35	March	4.87½	5.22½
April	6.77½	8.02½	April	5.00	5.85
May	6.70	7.52½	May	5.75	5.82½
June	6.57½	6.82½	June	5.35	6.20
July	6.67½	7.00	July	5.22½	5.62½
August	6.90	8.37½	August	5.00	5.40
September	8.25	9.05	September	4.72½	5.05
October	6.85	8.52½	October	4.62½	5.15
November	6.80	7.35	November	4.80	5.12½
December	6.62½	7.02½	December	5.05	5.65
1895:			1899:		
January	6.30	6.95	January	5.45	5.77½
February	6.30	6.70	February	5.15	5.67½
March	6.37½	7.17½	March	5.15	5.35
April	6.70	7.05	April	5.12½	5.30
May	6.50	6.75	May	4.90	5.20
June	6.42½	6.62½	June	4.90	5.10
July	6.12½	6.55	July	5.05	5.52½
August	5.80	6.25	August	5.15	5.45
September	5.72½	5.97½	September	5.17½	5.52½
October	5.45	5.90	October	5.20	5.60
November	5.37½	5.62½	November	4.95	5.20
December	5.15	5.37½	December	5.05	5.67½
1896:			1900:		
January	5.27½	5.85	January	5.72½	6.05
February	5.25	5.80	February	5.65	6.07½
March	5.00	5.40	March	5.70	6.55
April	4.67½	5.07½	April	6.45	7.35
May	4.10	4.80	May	6.72½	7.07½
June	3.85	4.27½	June	6.47½	7.07½
July	3.05	3.90	July	6.60	6.90
August	3.10	3.50	August	6.60	6.90
September	3.17½	3.82½	September	6.67½	7.20
October	3.85	4.55	October	6.77½	7.40
November	3.70	4.30	November	6.85	7.25
December	3.70	3.95	December	6.75	7.22½
1897:			1901:		
January	3.80	4.05	January	6.90	7.50
February	3.67½	4.00	February	7.35	7.52½
March	3.95	4.25	March	7.35	8.35
April	4.05	4.25	April	8.10	8.62½
May	3.55	4.12½	May	7.85	8.27½
June	3.42½	4.15	June	8.15	8.80
July	3.80	4.30	July	8.40	8.70
August	4.20	4.85	August	8.55	9.97½
September	4.35	4.90	September	8.95	10.25
October	4.15	4.52½	October	8.60	9.97½
November	4.15	4.32½	November	8.47½	9.60
December	4.20	4.72½	December	9.37½	10.15

RULES AND REGULATIONS OF THE BUREAU OF ANIMAL INDUSTRY ISSUED IN 1901.

[Amendment No. 1 to B. A. I. Order No. 46.]

REGULATIONS FOR THE INSPECTION AND SAFE TRANSPORT OF ANIMALS FROM THE UNITED STATES TO FOREIGN COUNTRIES.

U. S. Department of Agriculture,
Office of the Secretary,
Washington, D. C., November 18, 1901.

It is hereby ordered, That in addition to the provisions of sec. 9 of B. A. I. Order No. 46, the following regulations shall be observed with reference to attendants for live stock exported from the United States to foreign countries:

1. That the attendants shall be assembled at least three hours before the sailing of the steamer, and at such a time of day that an employee of this Department may examine them.

2. The examination shall be made before the signing of the ship's articles by the attendants, and any man who fails to conform to the following conditions shall be rejected:

First. The men employed must be able to speak English or sufficient English to make themselves understood or to understand orders given them.

Second. They must know for what purpose they are employed and the duties that will be required of them.

Third. They must be able-bodied and physically competent to perform the duties required.

Fourth. Each man entitled to return passage shall be supplied with return transportation before acceptance. All men not receiving such transportation shall be so informed by the Department employee.

Inspectors in charge of the ports are directed to carefully enforce the above regulations.

James Wilson, *Secretary.*

[Amendment No. 5 to B. A. I. Order No. 56.]

REGULATIONS FOR THE INSPECTION AND QUARANTINE OF HORSES, CATTLE, SHEEP, AND OTHER RUMINANTS, AND SWINE IMPORTED INTO THE UNITED STATES.

U. S. Department of Agriculture,
Office of the Secretary,
Washington, D. C., March 21, 1901.

It is hereby ordered, That rule 5 of the regulations for the inspection and quarantine of horses, cattle, sheep, and other ruminants, and swine, issued under date of December 28, 1899, B. A. I. Order No. 56, as amended by B. A. I. Order No. 79, issued November 10, 1900, be, and is hereby, amended to read as follows: All cattle over six months old imported from Great Britain directly into the United States after December 1, 1900, which are subject to quarantine, and except as otherwise provided, shall be tested with tuberculin by an inspector of this Department, stationed in that country, or after arrival at the animal quarantine station at the port of entry. Cattle from countries not otherwise provided for shall be tested in the said quarantine station. All cattle so tested which show a reaction shall be prohibited from entry into the United States, or be disposed of as provided in section 10 of above regulations.

It is further ordered, That rule 6 (paragraph *c*) be, and is hereby, amended as follows: A certificate for cattle over six months old for breeding purposes and for milch cows must also show that they have been submitted to the tuberculin test by an official veterinarian of the Canadian government or an inspector of this Department and found free from tuberculosis, giving the date and place of testing, with the chart of reaction, and a description of the cattle, with age and markings.

JAMES WILSON, *Secretary*.

Those desiring animals tested abroad should address Dr. Tooie A. Geddes, care of U. S. Consul-General's office, London. Those desiring cattle tested in Canada should address Dr. E. L. Volgenau, Live Stock Exchange Building, East Buffalo, N. Y.

Permits required by rule 9 for cattle and other animals must be obtained as heretofore.

(Amendments Nos. 1 to 4 were issued as B. A. I. Orders Nos. 58, 64, 77, and 79.)

[AMENDMENT NO. 6 TO B. A. I. ORDER NO. 56.]

REGULATIONS FOR THE INSPECTION AND QUARANTINE OF HORSES, CATTLE, SHEEP, AND OTHER RUMINANTS, AND SWINE IMPORTED INTO THE UNITED STATES.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., October 4, 1901.

It is hereby ordered, That rule 1 of the regulations for the inspection and quarantine of animals imported into the United States, issued under date of December 28, 1899 (B. A. I. Order No. 56), be and is amended by the addition of Lowelltown, Me. (port of Bangor, Me.), as a point for the entry of animals during the months of October and November, 1901, which require inspection only and are not subject to quarantine.

JAMES WILSON, *Secretary*.

[AMENDMENT NO. 7 TO B. A. I. ORDER NO. 56.]

REGULATIONS FOR THE INSPECTION AND QUARANTINE OF HORSES, AND CATTLE, SHEEP, AND OTHER RUMINANTS, AND SWINE IMPORTED INTO THE UNITED STATES.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., October 16, 1901.

It is hereby ordered, That rule 1 of the regulations for the inspection and quarantine of animals imported into the United States, issued under date of December 28, 1899 (B. A. I. Order No. 56), be and is amended by the addition of Alburg, Vt., and Swanton, Vt. (port of Burlington, Vt.), as points for the entry of animals which require inspection only and are not subject to quarantine.

JAMES WILSON, *Secretary*.

[AMENDMENT NO. 8 TO B. A. I. ORDER NO. 56.]

REGULATIONS FOR THE INSPECTION AND QUARANTINE OF HORSES, AND CATTLE, SHEEP, AND OTHER RUMINANTS, AND SWINE IMPORTED INTO THE UNITED STATES.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., November 23, 1901.

It is hereby ordered, That rule 1 of the regulations for the inspection and quarantine of animals imported into the United States, issued under date of December 28, 1899

(B. A. I. Order No. 56), be, and is hereby, amended by the addition of the subpo
of Blaine, Sumas, and Seattle, Wash. (port of Port Townsend, Wash.), as points f
the entry of imported animals which require inspection only and are not subject
quarantine.

JAMES WILSON, *Secretary.*

[B. A. I. ORDER NO. 80, AMENDMENT NO. 10.]

REGULATIONS CONCERNING CATTLE TRANSPORTATION.

Feeding Stations at Fort Worth and Baird, Tex.; Bakersfield, Cal., a Salisbury N.C.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 31, 1901.

It is hereby ordered, That cattle originating outside, north, east, and west of t
quarantine line as defined in Bureau of Animal Industry Order No. 80 (Decemb
10, 1900), or amendments thereto, and which are to be transported by rail throu
the quarantined district, may be unloaded for rest, feed, and water into uninfect
pens set apart for such cattle at Union Stock Yards, Fort Worth and Baird, Te
Bakersfield, Cal.; and Salisbury, N. C., providing the cattle are free from Southe
cattle ticks and have not been unloaded at any other place within the quarantin
district. They may, after unloading into said pens, be reloaded into the same ca
from which unloaded or into other cleaned and disinfected cars, and reshipped
uninfected cattle.

All prior orders conflicting herewith are hereby revoked.

JAMES WILSON, *Secretary.*

(Amendments Nos. 1 to 9 were issued as B. A. I. Orders Nos. 81 to 89.)

[AMENDMENT NO. 11 TO B. A. I. ORDER NO. 80.]

REGULATIONS CONCERNING CATTLE TRANSPORTATION.

Moving Cattle from Two Northern Tiers of Counties in Arkansas.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., February 5, 1901.

It is hereby ordered, That B. A. I. Order No. 80 be amended so as to permit t
shipment of cattle for purposes other than immediate slaughter from the two northe
tiers of counties in the State of Arkansas into the noninfected area: *Provided*, Th
said cattle have remained in the above-described counties since January 1 of th
year and have been inspected by officers of the Bureau of Animal Industry of th
Department and found to be free of splenetic, or Texas, fever and not to have be
exposed to the contagion thereof; that proper facilities shall have been afforded f
making such inspection, and that after inspection the cattle shall be shipped witho
delay and without exposure to the infection of splenetic, or Texas, fever.

Provided further, That no cattle shall be allowed shipment under this order unle
accompanied by a written permit issued by an inspector of the Bureau of Anim
Industry, nor shall such cattle be taken into any State or Territory contrary to t
local regulations; and said permission will be granted only for cattle which are
remain within the State to which destined for three months after arrival.

This order to remain in force until April 1, 1901.

JAMES WILSON, *Secretary.*

[AMENDMENT No. 12 TO B. A. I. ORDER No. 80.]

REGULATIONS CONCERNING CATTLE TRANSPORTATION.

Special Order Permitting Movement of Cattle from Certain Portions of Oklahoma.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., April 18, 1901.

It is hereby ordered, That B. A. I. Order No. 80 be amended so as to permit the shipment of cattle to any point above the Federal quarantine line from that portion of the counties of Oklahoma, Logan, and Noble lying west of the right of way of the Atchison, Topeka and Santa Fe Railway Company, in the Territory of Oklahoma, and including that part of the Otoe and Ponca Indian reservations lying west of said right of way: *Provided,* That such cattle have been held in the above-described area since January 1, 1901, and have been inspected by an officer of the Bureau of Animal Industry of this Department and found free of splenetic, or Texas, fever and not to have been exposed to the contagion thereof.

And provided further, That no cattle shall be allowed shipment under this order unless accompanied by a written permit issued by an inspector of the Bureau of Animal Industry, and all such cattle shall be subject to laws and regulations of the State to which destined. The cars in which such cattle are shipped must be free from infection and satisfactory to the inspectors.

This order to remain in force until otherwise ordered.

JAMES WILSON, *Secretary.*

[AMENDMENT No. 13 TO B. A. I. ORDER No. 80.]

SPECIAL ORDER PROVIDING FOR RETURN TO NONINFECTED DISTRICT OF CATTLE EXHIBITED AT THE SOUTHERN INTERSTATE FAIR AT ATLANTA, GEORGIA.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., April 20, 1901.

It is hereby ordered, That cattle from above the Federal quarantine line which have been shipped directly from the noninfected district to the fair grounds at Atlanta, Ga., for exhibition at the Southern Interstate Fair of 1901, and which are returned without having been unloaded elsewhere, be permitted to return as uninfected cattle: *Provided,* They are accompanied by a certificate issued by an inspector of the Bureau of Animal Industry of this Department showing that such cattle have had no opportunity to become infected with the cattle tick (*Boophilus annulatus* [*B. bovis*]) while at said grounds.

JAMES WILSON, *Secretary.*

[AMENDMENT No. 14 TO B. A. I, ORDER No. 80.]

REGULATIONS CONCERNING CATTLE TRANSPORTATION.

Feeding Station at Polk Stock Yards, Fort Worth, Texas.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., July 13, 1901.

It is hereby ordered, That cattle originating outside—north, east, or west—of the Federal quarantine line as designated in Bureau of Animal Industry Order No. 80 (December 10, 1900), or amendments thereto, and which are to be transported by rail through the quarantined district may be unloaded for rest, feed, and water, into uninfected pens set apart for such cattle at the Polk stock yards, Fort Worth, Texas, providing the cattle are free from Southern cattle ticks and have not been unloaded at any other place within the quarantined district. They may, after unloading into said pens, be reloaded into the same cars from which unloaded or into other clean and disinfected cars and reshipped as uninfected cattle.

This order to take effect when the pens of the Polk stock yards have been cleaned and disinfected to the satisfaction of inspectors of the Bureau of Animal Industry.

JAMES WILSON, Secretary.

[AMENDMENT No. 15 TO B. A. I. ORDER No. 80, MODIFYING ORDER No. 86.]

SPECIAL ORDER PERMITTING CATTLE FROM INFECTED ARE IN CALIFORNIA TO BE EXHIBITED AT THE CALIFORNIA STAT FAIR AT SACRAMENTO, SEPTEMBER 2 TO 14, 1901.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., August 21, 1901.

It is hereby ordered, That cattle from that part of California quarantined on accou
of Southern cattle fever may be exhibited at the California State Fair at Sacrament
September 2 to 14, 1901, provided they are shipped direct from point of origin to t
fair grounds in clean and disinfected cars, and that they are accompanied by a ce
tificate issued by the State veterinarian stating that he has inspected the catt
before shipment and found them to be free from the Texas fever tick (*Boophil*
annulatus [*B. bovis*]), and that while at the fair grounds said cattle are not broug
into contact with other cattle from the noninfected area; and when the exhibition
closed said cattle shall be shipped direct from the fair grounds to the quarantin
area.

WILLIS L. MOORE, *Acting Secretary.*

[AMENDMENT No. 16 TO B. A. I. ORDER No. 80.]

REGULATIONS CONCERNING CATTLE TRANSPORTATION.

Feeding Station at Los Angeles, Cal.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., October 3, 1901.

It is hereby ordered, That cattle originating outside—north, east, or west—of th
Federal quarantine line as defined in Bureau of Animal Industry Order No.
(December 10, 1900), or amendments thereto, and which are to be transported b
rail through the quarantined district, may be unloaded for rest, feed, and water int
uninfected pens set apart for such cattle at the Southern Pacific Railway stock yard
Los Angeles, Cal.: *Providing,* That cattle are free from Southern cattle ticks and hav
not been unloaded at any other place within the quarantined district. They ma
after unloading into said pens, be reloaded into the same cars from which unloade
or into other clean and disinfected cars and reshipped as uninfected cattle.

JAMES WILSON, *Secretary.*

[AMENDMENT No. 17 TO B. A. I. ORDER No. 80.]

REGULATIONS CONCERNING CATTLE TRANSPORTATION.

Infected Cattle, Clinton County, Kentucky.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., October 15, 1901.

In consequence of splenetic, or Southern, fever infection being present among catt
in Clinton County, Ky., as shown by the number of cattle in that county infeste
with the Southern cattle tick (*Boophilus annulatus*), and to prevent the spread
infection,

It is hereby ordered, That no cattle which are in said county or which may be taken t
said county during the continuance of this order, shall be removed from said count
and shipped to any State or Territory, except for immediate slaughter and according t
the regulations of this Department, as specified in Bureau of Animal Industry Orde
No. 80, dated December 10, 1900, or amendments thereto, for the movement
Southern cattle. This order to continue from this date to November 15, 1901.

JAMES WILSON, *Secretary.*

[AMENDMENT No. 18 TO B. A. I. ORDER No. 80.]

REGULATIONS CONCERNING CATTLE TRANSPORTATION.

Restrictions Modified.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., October 22, 1901.

It is hereby ordered, That section 3 of B. A. I. Order No. 80, dated December 10, 1900, providing for the movement of cattle from the quarantined district described by said order and amendments thereto, be amended as follows:

From November 15, 1901, to January 31, 1902, inclusive, cattle from said area may be moved to such points within the States of Virginia, North Carolina, Tennessee, Missouri, Kansas, and Texas, and the Territories of Oklahoma, New Mexico, and Arizona, as may be provided for in the regulations of these States and Territories and permitted by the local authorities in charge. In the absence of such local regulations and permission, all movement of cattle from the quarantined district to points outside of said district in above-named States and Territories is prohibited. All cattle from the quarantined district destined to points outside of the States and Territories above named may be shipped without inspection between November 15, 1901, and January 31, 1902, inclusive, and without restrictions other than may be enforced by local regulations at point of destination. The reshipment of any cattle which may have been moved under this order to any part or parts of the States of Virginia, North Carolina, Tennessee, Missouri, Kansas, and Texas, and the Territories of Oklahoma, New Mexico, and Arizona, except by permission of the proper authorities of said States and Territories, is hereby prohibited.

And it is further ordered, That all stock pens which may have been reserved for the use of cattle from the quarantined district, prior to November 15 next, shall not be used for receiving or storing cattle from the quarantined district which have been inspected and passed, nor for cattle originating outside of the quarantined district, except when such cattle are intended for immediate slaughter.

JAMES WILSON, *Secretary.*

[B. A. I. ORDER No. 90.]

SPECIAL ORDER PROVIDING FOR THE IMPORTATION OF CANADIAN CATTLE, SHEEP, AND SWINE FOR EXHIBITION PURPOSES AT INTERNATIONAL LIVE-STOCK EXPOSITION, CHICAGO, ILL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., September 12, 1901.

It is hereby ordered, That Canadian cattle may be imported into the United States for exhibition purposes at the International Live-Stock Exposition, to be held from November 30 to December 7, 1901, at Chicago, Ill., without being subjected to the tuberculin test: *Provided*, That they must be accompanied by a certificate issued by a Canadian official veterinarian, stating that such cattle are free from contagious and infectious diseases: *And provided further*, That they must be returned immediately to Canada at the close of the exposition.

All Canadian cattle, sheep, and swine intended for this exposition must be shipped directly to the exposition grounds and not unloaded in any public stock yard.

J. H. BRIGHAM, *Acting Secretary.*

[B. A. I. ORDER No. 91.]

RULES AND REGULATIONS FOR THE INSPECTION AND MARKING OF DAIRY PRODUCTS FOR EXPORT.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., October 30, 1901.

The following rules and regulations are hereby prescribed to initiate the inspection of dairy products offered for export from the United States, by virtue of the authority conferred upon the Secretary of Agriculture under the provisions of the act of

Congress approved March 3, 1891, and amendments thereto approved March 2, 1
and March 2, 1901, and will be observed until further notice:

1. Owners or shippers of butter, cheese, or dairy products which are to be expo
and who desire to have the said articles from time to time inspected and so mar
"as to secure their identity and make known in the markets of foreign count
* * * their purity and quality" shall make application in writing for such ins
tion, addressed to the Secretary of Agriculture.

2. The said application shall state the location or place of business of the p
making the same, and also the usual place or places at which the products ma
inspected and from which they are directly transported to the exporting vessel,
frequency of such exports, the character and average number of packages of
products and the maximum number of packages of like character exported at
time within one year preceding said application (this being simply as an indica
of the bulk of future business and probable inspection requirements), and the ap
cant in said application shall agree to conform with all lawful regulations, ord
and instructions that may be made by the Secretary of Agriculture and Chief of
Bureau of Animal Industry for carrying on such work of inspection.

3. The Secretary of Agriculture will designate an inspector to make the exami
tion, with such assistants as may be necessary to expeditiously accomplish the w
of inspection.

4. The exporter or applicant will notify the inspector of every shipment to
made by him, at least twelve hours (and preferably two or three days) before
necessary to move the same to the shipping point, and briefly describe the locati
character, and quantity of the products to be examined.

5. The inspector designated for the service shall examine products for ex
specified in such notice, with the least possible delay. In every lot of product
apparently identical origin and character he shall examine the contents of as m
packages as in his judgment will determine the character of that lot, and then a
to every package of the lot so inspected, the brand, label, or mark provided and
scribed by the Secretary of Agriculture for that purpose. Such mark shall inclu
statement of the inspection and the law authorizing the same, of the purity
character of the product, the name of the inspecting officer, and the date of inspecti

6. The inspector shall mark only such products as he finds to be pure and m
chantable and of a quality and grade at least equal to the minimum standard to
prescribed for the product concerned, from time to time, by the Secretary of A
culture. During any one period this standard shall be uniform for all parts of
United States. If upon examination the inspector finds products of doubtful pu
or in quality below the standard prescribed for the time being, he shall decline
place any mark thereon or give any certificate regarding the same. And he sh
likewise decline to mark or certify to any products which upon their packages
otherwise bear commercial or other marks, labels, or brands, which misrepres
the true nature, character, or grade of such products.

7. The inspector may, upon application, prepare and deliver to an exporter a c
tificate in duplicate of the form prescribed by the Secretary of Agriculture relating
specified products already inspected and marked.

8. No products shall be inspected until the time and manner of their export tra
portation have been determined and the packages have been completely marked
shipment. No mark shall be added by or for the shipper after the goods have b
inspected, unless it be with the approval and in the presence of the inspector.

9. "All the provisions of the said act (approved March 3, 1891) relating to l
cattle and products thereof for export shall apply to dairy products so inspected a
certified." This particularly relates to the provisions of section 4 of said act
regard to counterfeiting, altering, defacing, and destroying marks, stamps, and c
tificates, and the penalties therefor.

10. All butter shall be deemed impure and shall not be marked or certified wh
contains any substance not derived from the pure milk of the cow, excepting o
common salt and harmless coloring matter, or which contains salt or water in exc
of that allowed by the standard of the country to which the article in question i
be exported.

11. All cheese shall be deemed impure and shall not be marked or certified wh
contains any substance not derived from the pure, unskimmed milk of the c
excepting only rennet, common salt, and harmless coloring matter.

12. All condensed milk or cream shall be deemed impure and shall not be mar
and certified which contains any substance not derived from the pure, unskimm
milk of the cow, excepting only sugar and harmless coloring matter.

13. Inspectors will be held individually responsible for all brands, stamps, lab
and certificates entrusted to them; all must be properly used and accounted f

Reports upon such property and regarding inspections made, must be rendered periodically and promptly, as per instructions to be given by the Chief of the Bureau of Animal Industry.

14. Inspectors will make requisition from time to time for all articles necessary for use in their duties, and will allow, whenever practicable, fifteen days for filling such requisions. Emergency calls for supplies must be fully explained.

JAMES WILSON, *Secretary of Agriculture.*

[B. A. I. ORDER No. 92.]

SPECIAL ORDER PROHIBITING THE LANDING OF ANIMALS FROM THE PHILIPPINE ISLANDS AT ANY OF THE PORTS OF THE UNITED STATES OR OF THE DEPENDENCIES THEREOF.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 13, 1901.

Notice is hereby given to the owners, officers, and agents of all steamers and other vessels of all descriptions plying between the Philippine Islands and any of the ports of the Hawaiian Islands, or between the Philippine Islands and any of the ports of the United States or the Territories or dependencies thereof, and to all stockmen and all other persons concerned in any way or manner in the traffic in animals in or with the Philippine Islands, that certain contagious, infectious, and communicable diseases dangerous to the live stock of the United States exist among the animals of the said Philippine Islands, viz: Surra, affecting horses, mules, asses, neat cattle, camels, buffaloes and dogs, and apes; foot-and-mouth disease, affecting horses, neat cattle, other ruminants and swine; and rinderpest, affecting neat cattle and other ruminants;

Therefore, under the authority conferred upon me by the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuropneumonia and other contagious diseases among domestic animals," I do hereby prohibit the landing at any of the ports of the Hawaiian Islands, or at any of the ports of the United States or of any of the dependencies thereof, of any live stock, or animals of any kind, from the Philippine Islands. This prohibition will take effect immediately and will continue in force until otherwise ordered.

JAMES WILSON, *Secretary.*

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